ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXX. No. 7.

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The track of the Atchison, Topeka & Santa Fe R. R. running out of Chicago has some Samson angle bars 36 ins. long, with four bolts spaced 9 ins. c. to c. There are also some six-bolt angle bars. The rails are laid with square, supported joints, and the switches are of the modified Wharton pattern.

Another Arctic expedition is announced as ready to start next spring under the direction of Mr. Robert Stein, of the U. S. Geological Survey. As outlined, Mr. Stein proposes to establish a depot and starting point at the mouth of Jones Sound and thence proceed overland north and westward through a hitherto unexplored region lying to the west of Grinnell Land. He estimates the entire cost of the expedition at $10,000 and believes that he can achieve in one summer interesting and valuable results.

Bids for three light-draft protected gunboats for the U. S. Navy have been called for and are to be opened on Oct. 17. The vessels are to be of 1,200 tons displacement and to have a speed of 13 to 14 knots per hour. Bidders may make proposals either on the basis of the plans and specifications prepared by the Bureau of Steam Engineering or on plans and specifications prepared by themselves, and a premium of $20,000 is offered for each knot of speed in excess of the contract requirement which is obtained on the trial trip. Intending bidders can obtain all information from the Bureau of Steam Engineering.

The rumor concerning the substitution of electric propulsion for steam on the Brooklyn elevated roads, referred to in our last issue, is said to be without foundation by those who are in a position to know. The rumor was probably started by parties interested in the surface trolley lines.

The Terre Haute Car Works, employing about 1,000 men, and one of the largest manufacturing interests of the town of Terre Haute, Ind., were burned on Aug. 10. Practically all of the buildings of the company and the stock on hand, including several hundred completed cars, are stated to have been destroyed. The company carried about $150,000 of insurance on the buildings and stock.

Nine electric hoists of the drum and winch-head type have been in use for about 30 months on the wharves of Sanderson & Sons in Brooklyn, which are used by the Wilson line of transatlantic steamers. Each hoist is equipped with a General Electric 10-HP. bipolar motor. The whole plant was installed by Messrs. Curtis & Dean. When the hoists were first put in there was great opposition on the part of the workmen, and the owners themselves were somewhat fearful as to the success of their venture. Experience has shown, however, that the electric hoists have many points of advantage over the steam machines which they superseded. In the matter of repairs, we are informed that the total expense for repairs on the nine hoists for the 30 months they have been in daily service has been $24.75, or an average annual expense of $1.50 per hoist. It need hardly be said that no steam engine of equal power could show such a record.

The most serious railway accident of the week occurred on Aug. 10 on the Philadelphia & Reading R. R. at Barnitz, Pa. A construction train ran into the rear of a freight train, and a passenger train soon after crashed into the rear of the construction train. Several trainmen were seriously injured.

The derailment of a train on the Paff Vale Ry., in Wales, on Aug. 12, resulted in the death of 16 persons and the injury of 40. Five of the wrecked cars went down an embankment a distance of 40 ft. The accident occurred at a sharp curve near Pont y Pridd, while the train was running about 30 miles per hour.

Bridge accidents have been numerous lately. A highway bridge span in Morgan County, Pa., went down on Aug. 5 under a wagon and span of horses.——A bridge at the barracks at Clemson Agricultural College, Calhoun, S. C., gave way Aug. 11 while about 50 students were standing on it.——An iron bridge over the Russian River at Hopland, Cal., fell Aug. 8 with a four-horse freight wagon. It is stated that the bridge had been built but a few years.——An old wooden bridge at Falls of Schuylkill, Pa., was wrecked in a wind storm on Aug. 6. The bridge was 600 ft. long and was built in 1861. Two spans were blown down in 1878, but were rebuilt. The bridge for some time has been considered unsafe and was closed to all travel on July 15.——The bridge across the Brazos River near Richmond, Tex., whose collapse we noted last week, was an iron structure built only a few years ago at a cost of $28,000. It is stated that the herd of cattle which was crossing it became frightened and started to run, and the structure then collapsed.——The threshing season has commenced to produce its annual crop of bridge accidents. While crossing a large covered bridge over the Scioto River, near Delaware, O., on Aug. 5, a steam threshing outfit and engine broke the structure down and fell into the river. The driver was seriously injured. The newspaper report states "the county commissioners carefully inspected the bridge with an engineer, and found it perfect, with no defects. The cause of the giving way was the bumping of the wheels and the great weight of the engine, which weighed eight tons."——Three bridges have been burned recently. The New York & New England R. R. bridge at Blackstone, R. I., was burned Aug. 8. It was a double-track Howe truss structure of 150 ft. span.——A bridge on a logging road in Baldwin County, Alabama, was burned Aug. 1, and a train ran into the river.——A Union Pacific bridge three miles east of Abilene, Kan., was burned Aug. 8; sparks from a passing train are thought to have been the cause.——The city of Minneapolis lost two bridges in the recent large fire there.——The Intercolonial Ry. lost about a mile of snowsheds by fire, near St. Charles, P. Q., on Aug. 9.

Two locomotives of the Cleveland & Pittsburg Ry. were burned with the engine house at New Philadelphia, O., on the morning of Aug. 13. On the same date two locomotives of the Niagara Central Ry. were burned while standing in the engine house at St. Catherines, Ont.

The Girard blast furnace at Youngstown, O., owned by A. M. Byers, of Pittsburg, was injured on Aug. 11 by an explosion of gas. A part of the stack was torn down and the stock house and casting house were set on fire. Five employees were fatally injured.

A masonry retaining wall about 40 ft. high on the Wheeling Terminal Ry., at Wheeling, W. Va., gave way recently. The wall was built on piles, and a large amount of stone filling from a tunnel excavation was placed behind it, and is claimed to have contributed to its destruction.

The rock-fill dam across the Pecos River, six miles above Eddy, N. Mex., was partially destroyed on Aug. 6. The dam was built in 1890 by the Pecos Irrigation and Investment Co., of Colorado Springs, Colo., and was illustrated and described in our issue of May 17, 1890. The dimensions were: Length, 1,040 ft.; greatest height above bedrock, 45 ft.; width of cross-section at water level, 21.5 ft.; at top, 6.5 ft. The dam was built as a rock fill, the lower side being allowed to take its natural slope of about 1 to 1, and the upper side being faced with a roughly laid rubble wall with a batter of ½ to 1. On this upper face an earth embankment was built with a slope of 1½ to 1. The spillway was cut in a solid limestone ridge, and it was not intended that any water should pass over the top of the dam. The spillway was at first intended to be 280 ft. wide, but was enlarged to 320 ft., with a depth of 5 ft. The rock channel in which the head gates were placed was 500 ft. long, 30 ft. wide and 25 ft. in greatest depth. The dam stored about 1,000,000,000 cu. ft. of water. We hope to give further particulars concerning the cause of the failure in a later issue.

The Victor Reservoir Co., says the Los Angeles "Express," is receiving bids for the construction of about 12 miles of main canal, under which lie 15,000 to 20,000 acres of choice land awaiting irrigation, the main part lying alongside the Atlantic & Pacific railway. The reservoir, when completed, will cover 7,600 acres to an average depth of 55 ft. with a 150-ft. dam. The total cost of reservoir and canal is estimated at $1,600,000. This is claimed to be the largest irrigation scheme in San Bernardino and Riverside counties, in Southern California.

The first locomotive was run through the Howard St. tunnel on the Baltimore Belt Ry. on Aug. 8 carrying a party which included Chief Engineer W. S. Manning and Resident Engineer Howett, Chief Inspector Corrigan and Mr. E. J. Farrell, of the contracting firm of Ryan & McDonald, with his assistants, H. B. Reed and W. E. Newell. The locomotive was one of those used by the contractors on the material trains which have now begun running through the tunnel to carry away the earth excavated at its north end.

Work on harbor improvements at Aransas Pass, Tex., is to be undertaken by a syndicate, provided $600.000 in land is subscribed by the residents of Aransas Pass and San Patricio counties. The syndicate is to receive one-third of the subscription when the present jetty is completed and extended 1,250 ft. and two-thirds when 15 ft. of water is secured on the bar. For each additional foot of water obtained over 15 ft. one-fifth the remaining part of the subscription will be payable. Messrs. J. C. Fulton, S. H. Smith and C. W. Booth, of Rockport, Tex., are the committee in charge of the matter.

The affairs of the Panama Canal Co. will shortly have another airing in the courts due to the efforts of the liquidators of the company to recover sums of money. It is said that M. Lemarquis, co-liquidator with M. Monchicourt, of the company, has applied for and been granted summonses against the members of the syndicates of contractors in civil proceedings to recover the sum of 6,000,000 francs alleged to have been secured by them without any equivalent. Summonses are said to have also been issued against several financial companies, including the old Comptoir d'Escompte, Credit Lyonnais, Credit Industriel, Societe Generale and Seligman Brothers. Proceedings have also been instituted by M. Lemarquis against eight of the directors of the Panama Canal Co.

Carved blocks of lava, 30 ft. long, 15 ft. wide and 6 ft. thick and weighing about 200 tons each, are found in the ruins of the once great city of Tiahuanaco, on the shore of Lake Titicaca, in Bolivia, says Dr. Alfred Stubel, a distinguished German explorer and geologist. He says few of the blocks used weighed less than 125 to 175 tons. Yet these stones were apparently brought from a distant point on the lake and dragged 20 miles from their landing place on the lake to their present site. Dr. Uhle, a German authority on South American archaeology, ascribes this work to the Aimara, an Indian race still existing in Bolivia and Peru, and he believes that the city of Tiahuanaco antedates the conquest of the Aimaras by the Incas, an event assigned by Spanish historians to the early part of the twelfth century.

Bids will be received until Oct. 4 by the Board of Trustees of the Sanitary District of Chicago, for the excavation of the main drainage channel of the Sanitary District between Willow Springs and Joliet, Ill. This work will consist of the excavation of about 1,484,800 cu. yds. of rock, 2,179,500 cu. yds. of earth, and the building of about 76,466 cu. yds. of rubble walls. Further information is given in our proposal columns, or can be obtained by addressing Mr. Thomas F. Judge, Clerk of the Board, Rialto Building, Chicago.

The submarine torpedo boat invented by John P. Holland, of New York city, has been recommended for adoption by the U. S. Navy by the Board of Naval Officers appointed to examine the plans of submarine boats submitted by American inventors in response to recent advertisements. The only other boat submitted which was worked out in much detail was that invented by Geo. C. Baker, of Washington, D. C., and in some points it is claimed to be the superior of the Holland boat. The claims of the two inventors are said to conflict on several points, and a compromise is proposed by which each inventor shall have the benefit of the other's special features.

THE EFFECT OF PUNCHING AND SHEARING STRUCTURAL STEEL.

The evidence is now almost conclusive that wrought iron, as produced by the puddling process, will be largely supplanted for structural material by the soft and medium grades of steel, i. e., steel with an ultimate tensile strength of from 55,000 lbs. to 70,000 lbs. per sq. in. The chief drawbacks to the common use of steel for structural purposes have been doubts as to its trustworthiness and especially doubts as to its ability to withstand shearing and punching in manufacture without serious injury. These doubts still maintain among many engineers, although all experiments go to show that there is little basis for them with steel not exceeding 80,000 lbs. per sq. in, tensile strength. Owing to the recent adoption of steel for structural purposes, however, such experiments have as yet been rather limited in number. The following series made to determine these particular points by Mr. James Christie, M. Am. Soc. C. E., and given in a paper on "The Treatment of Metals for Structural Purposes," presented at the International Engineering Congress, at the World's Columbian Exposition, are, therefore, of especial interest. The following is a description of the experiments made and the results obtained, somewhat condensed and rearranged for convenient reference:

It has heretofore been the usual custom to use the punch and shears for the preparation of structural iron. As steel became extensively used an impression gained that similar treatment was especially injurious to this metal, and as long as the raw material was of greater pecuniary value than iron there existed considerable disinclination to use it unless all cut edges were planed, and holes either reamed after punching or drilled from the solid. There is no doubt that steel of higher tensile strength than is now accepted for structural purposes should not be punched or sheared, or that the softer material may contain elements prejudicial to its use, however treated, but especially if punched. But extensive evidence is now on record indicating that steel of good quality, in bars of moderate thickness, and below or not much exceeding 80,000 lbs. tensile strength, is not any more, and frequently not as much, injured as wrought iron by the process of punching or shearing. There is subjoined the results of a series of experiments made within the past two years under the observation of the writer. The latter were made by skilled operators with the sole intention of getting the facts of the case.

General Effects of Shearing and Punching.—The cutting tool compresses or displaces the material immediately at the edges cut, slightly reducing the thickness, the amount of reduction being dependent upon the thickness of the material cut. Iron sheared in the direction of the fibers is usually much more roughened than when cut across the fibers. Steel usually shows a much smoother sheared edge than iron, but sometimes very minute cracks are observable across the edge of sheared steel. It is known that the effects of the disturbance are very superficial, as the removal of the visible roughness by planing or reaming respectively for sheared and punched surfaces apparently reestablishes the original condition. The physical effects of punching and shearing as denoted by tensile test are, for iron and steel: (1) Reduction of ductility. (2) Elevation of tensile strength at elastic limit. (3) Reduction of ultimate tensile strength.

In very thin material the superficial disturbance described is less than in thick; in fact, a degree of thinness is reached where this disturbance practically ceases. On the contrary, as thickness is increased, the injury becomes more evident. The effects described do not invariably ensue; for unknown reasons, there are sometimes marked deviations from what seems to be a general result.

By thoroughly annealing sheared or punched steels the ductility is to a large extent restored, and the exaggerated elastic limit reduced, the change being modified by the temperature of reheating and the method of cooling. The fractured sections of steel may exhibit either a clear crystalline structure or a dull, semi-fibrous appearance, usually known as "silky," and especially observed in bars of uniform section, which, when pulled apart, stretch considerably and show considerable reduction of the fractured area, generally also breaking with a raised and depressed coning or a beveling of the broken surfaces. The character of the fracture is to some extent indicative of the method of fracture, or of how fracture is begun, rather than quality of material. Bars nicked and broken transversely show a crystalline fracture, as may also punched bars of considerable thickness when pulled to rupture, while the same punched bars reamed may exhibit a silky fracture when pulled. Illustration of this action is given hereafter. It will be observed that the disturbance of the material by the treatment, especially by shearing, was much greater in the tested specimens than would occur ordinarily in practice, owing to the extent of disturbed surface being large in proportion to the limited dimensions of the specimen. The effects of treatment, as denoted in the experiments, are therefore an exaggerated record of what ordinarily occurs in practice.

The following is a list of the abbreviations used in the tables:

T. S. = ultimate tenacity in pounds per square inch of original section.

E. L. = tensile strength at elastic limit in pounds per square inch of section.

St. = stretch per cent. in 8 ins. of the fractured specimen.

Red. = reduction per cent. of fractured area.

The elastic limit was recorded at the point when the scale beam dropped, sometimes given as the yield point. Stretch measured in a length of 8 ins., excepting perforated specimens, when it is measured in 2 ins., unless otherwise stated.

Series 1.—A series of 42 tests was made on steel plates 6 ins. wide, ¼, five-sixteenths and ⅜ ins. thick, with holes 11-16, 13-16 and 15-16 in. diameter pierced across the width as shown in Fig. 1. One-half the lot was pierced with three holes, the other half with four holes. The following table shows the tensile tests with open holes, being a combined average for the series:

Treatment.	T. S.	E. L.	St. P. C.
Rolled..............	62,100	39,800	28.6 in 8 ins.
Punched............	66,400	50,300	11.5 in 2 "
Punched and annealed	66,560	42,450	15.2 in 2 "
Drilled...............	67,000	51,370	15.1 in 2 "

The abrupt reduction of sectional area on the line of the holes accounts for the elevation of tensile strength per unit of net section above that of the original bars.

Series 2.—This series of 27 tests was made on iron plates with open holes arranged as shown in Fig. 2. The original strength of the plates unpunched, as given by an average of one test for each thickness, was: Tensile, 53,000 lbs.; elastic limit, 32,800 lbs.; stretch in 8 ins., 18.2%, and reduction of area, 0.28%. Table 1 shows the results of the tests.

Table 1.

Thickness.	Holes, in.	No. of tests.	Total load.	Per sq. in. Max. load,	Per sq. in. E. limit,	St. p. c. in 8 ins.
½	P. $\frac{15}{16}$	3	82,016	32,373	29,050	4.1
½	P. $\frac{11}{16}$ R. $\frac{31}{32}$	3	97,800	38,720	28,070	6.2
½	P. ¾ R. $\frac{31}{32}$	3	95,766	37,850	28,550	5.1
⅝	P. $\frac{15}{16}$	3	101,183	31,490	27,800	4.46
⅝	P. $\frac{11}{16}$ R. $\frac{31}{32}$	3	121,233	37,890	26,483	7.43
⅝	P. ¾ R. $\frac{31}{32}$	3	123,183	38,600	27,680	6.8
¾	P. $\frac{15}{16}$	3	121,263	31,746	27,963	4.76
¾	P. $\frac{11}{16}$ R. $\frac{31}{32}$	3	142,166	36,950	27,436	5.86
¾	P. ¾ R. $\frac{31}{32}$	3	144,833	37,816	26,286	6.90

P = punched; R = reamed.

Series 3.—These tests were made on steel plates alike in all particulars to the iron pates tested in Series 2. All plates were rolled from one billet, and their original strength, as shown by one test for each thickness, was: Tensile, 64,300 lbs.; elastic limit, 39,300 lbs.; stretch in 8 ins., 28.9%; reduction of area, 57.3%. The percentages of carbon, phosphorus and manganese were 0.16%, 0.077% and 0.51%, respectively. The results of the tests are shown in Table 2.

Table 2.

Thickness.	Holes, in.	No. of tests.	Total load.	Per sq. in. Max. load.	Per sq. in. E. limit.	St. p. c. in 8 ins
½	P. $\frac{15}{16}$	3	116,283	47,563	34,040	7.46
½	P. $\frac{11}{16}$ R. $\frac{15}{16}$	3	131,850	54,373	32,703	10.53
½	P. ¾ R. $\frac{15}{16}$	3	130,600	53,063	32,766	10.7
½	D. $\frac{15}{16}$	3	134,166	54,550	32,373	11.
⅝	P. $\frac{15}{16}$	3	143,266	46,276	32,643	7.3
⅝	P. $\frac{11}{16}$ R. $\frac{15}{16}$	3	170,850	54,620	31,560	10.6
⅝	P. ¾ R. $\frac{15}{16}$	3	157,800	50,410	31,680	9.9
⅝	D $\frac{15}{16}$	3	169,933	54,413	31,620	11.43
¾	P. $\frac{15}{16}$	3	151,400	40,103	32,700	4.96

P = punched; R = reamed; D = drilled.

Series 4.—A series of 12 tests, made on steel bars 4½ ins. wide and 11-16 in. thick, in all respects like Tables 1 and 2, except that the parallel rows of holes were 2¼ ins. apart, resulted as follows:

	T. S.	E. L.	St.	Red.
Bars rolled..............	62,800	37,200	27.8	52
Punched $\frac{15}{16}$ in..........	40,800	35,100	1.7	..
Punched ¾ in Reamed $\frac{15}{16}$ in	51,900	31,400	12.5	..

In this instance every punched bar broke with a crystalline fracture, and every reamed bar with a silky fracture. In the three foregoing cases, as the holes in specimens were not on the same line at right angles to length of bar, the effective net section was taken as the product of thickness and width of bar, less the diameter of one hole. But owing to eccentricity of strain, the specimens always broke by starting at one edge and tearing across, which accounts for the tensile strength of perforated bars being apparently so much less than the original.

Series 5.—To determine the effect of punching, punching and reaming, or drilling steel bars, tests were made on bars rolled 3 ins. wide with holes perforated through the middle of the bar and treated as described. Results of the various tests are given in Table 3.

Table 3.

Size of bar. Ins.	Treatment. Ins.	T. S.	E. L.	St.	Red.	Fracture.
3 × ⅜......	Rolled.	65,900	41.800	29	54	Silky
	P 1	60,800	46,100	11	13	"
	P ⅞ R $\frac{15}{16}$	52,600	39,500	12	32	"
	D 1	65,500	45.000	15	29	"
3 × ⅝......	Rolled.	61,900	36,400	31	53	"
	P 1	52,300	51,100	2.3	5.6	Cryst.
	P ⅞ R $\frac{15}{16}$	60,200	46,700	14	25	Silky
3 × ¾......	Rolled.	6· .300	37,300	31	49	"
	P 1	46,300	44,200	7.3	3.7	Cryst.
	P ⅞ R $\frac{15}{16}$	55,000	45,700	4	27	"
3 × ⅞......	Rolled.	63,100	39,900	32	55	Silky
	P 1	51,000	47,200	2.3	4	Cryst.
	P ⅞ R $\frac{15}{16}$	65,900	49,400	14	20	Silky
3¾ × ⅞ 4 tests of each......	Rolled.	70,500	37,900	26.7	47	......
	D $\frac{15}{16}$	73,000	39.000	10	..	......
	P $\frac{11}{16}$ R $\frac{15}{16}$	73,700	39,400	11	..	......

D = drilled, P = punched, R = reamed.

The elongations were measured for solid bars in a length of 8 ins., for the perforated bars in 3 ins., except the last item of 3¾ × ⅞ in., in which elongation was measured in 2 ins. for perforated bars.

Series 6.—Table 4 shows the effect of shearing the edges. The strips were sheared lengthwise from the same bars of each thickness and tested in strips varying from 1½ to 3 ins. wide. All specimens were cut from bars varying from 6 to 10 ins. wide. Those with planed edges were previously sheared, $\frac{1}{16}$ to ⅛ in. of material being removed by the planing.

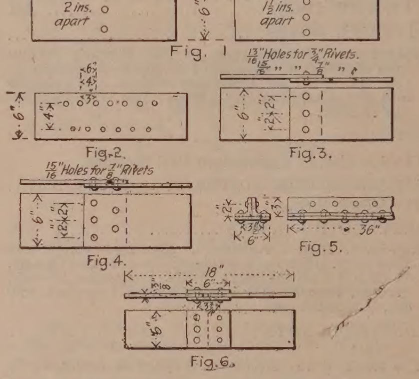


Fig. 1
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.

Diagrams Showing Construction of Test Pieces.

Table 4.

Steel, thi'k., in.	Treatment of edges.	T. S.	E. L.	St.	Red.
$\frac{5}{16}$	Sh'r'd........	64,600	45,100	10.6	28.
$\frac{5}{16}$	Pl'n'd........	65,100	41 600	23.2	61.8
½	Sh'r'd........	68,800	43,600	16.1	28.3
½	Pl'n'd........	69,000	43,000	25.7	57.8
$\frac{11}{16}$	Sh'r'd........	64,300	41,600	16.5	25.
$\frac{11}{16}$	Pl'n'd......	61,600 Doubtful	37,200	28.4	47.5
Gen. av. sh'r'd edges..		65,900	43,600	14.4	27.1
Pl'n'd edges............		67,000	40,600	25.8	55.7

A series of strips 1½ to 3 ins. wide, cut from iron bars 8 to 10 ins. wide and ⅜ to ½ in. thick, gave results as follows as a combined average of a dozen tests:

Iron, th'ck., in.	Treatment of edges.	T. S.	E. L.	St.	Red.
⅜ to ½	Sh'r'd.......	45,500	33,100	5.6	18.
	Pl'n'd	48,900	31,700	12.3	24.8

A bar $\frac{11}{16}$ in. thick, of 7-in. flat iron, cut and tested as follows:

Iron, in.	Treat. of edges.	T. S.	E. L.	St.	Red.
1.5 × $\frac{11}{16}$	Pl'n'd..........	47,300	Doubtful 34,200	15	21
1.6 × $\frac{11}{16}$	Sh'r'd..........	38,300	30,400	4	13
2.9 × $\frac{11}{16}$	Sh'r'd	38,600	29,900	5	14

Series 7.—Strips of the widths given in the following table were sheared from 7-in. steel bars ¼ and ½ in. thick. A portion of them had ⅛ in. planed from each edge, others were annealed by heating to redness and burying in dry sand, and some of the planed pieces, marked overheated, were heated to a bright yellow heat, forming scale, and cooled in the atmosphere. Tension tests resulted as shown in Table 5, with silky fracture:

Table 5.

Steel, in.	Treat. of edges.	T. S.	E. L.	St.	Red
1.9 × ¼	Pl'n d...............	62,200	42,800	27	60
1.6 × ¼	Sh'r'd.............	62,600	44,000	16	22
1.5 × ¼	Sh'r'd and an'ld..	63,800	44,200	22	51
1.5 × ¼	Pl'n'd a'd ov'h't d.	60,700	41,100	29	60
1.9 × ½	Pl'n'd...............	57,300	37,200	31	59
1.6 × ½	Sh'r'd...........	64,700	43,400	18	26
1.4 × ½	Sh'r'd and an'l'd..	61,300	41,400	26	53
1.3 × ½	Pl'n'd a'd o'vh't'd.	61,300	37,300	30	61

Bars from same bloom, rolled 7 ins. wide, ⅜, ½ and ⅝ in. thick, all sheared lengthwise into strips and pulled as shown in Table 6.

Table 6.

Specimen. Width, thickness, ins.	Treatment of edges.	T. S.	E. L.	St.	Red.
1½ × ⅜	Planed	79,200	45,800	22	51½
1½ × ⅜	Sheared..........	79,700	44,500	9	23
3 × ⅜	"	79,600	43.000	14½	25½
1½ × ⅜	Sh'red and an'ld..	83,100	50,900	19¼	31¼
1⅜ × ⅜	Pl'n'd & ov'rh't'd.	82,000	46,900	22	49¾
1½ × ½	Planed..........	78,500	39,600	26	52
1½ × ½	Sheared..........	79,400	43,400	11	15
3 × ½	"	77,700	38,800	14	21
1½ × ½	Sh'red and an'l'd.	80,800	46 900	20	27
1⅜ × ½	Pl'n'd & ov'rh't'd.	80,900	43,400	22	35
1½ × ⅝	Planed..........	78,600	41,800	24	45
1½ × ⅝	Sheared..........	81,100	47,200	14	14
3 × ⅝	"	79,600	44,400	17	19
1½ × ⅝	Sh'red and an'l'd.	82,300	47,400	22	37
1¼ × ⅝	Pl'n'd & ov'rh't'd.	80,800	49.700	26	53
1½ × ¾	Planed	82,200	43,500	24	50
1½ × ¾	Sheared..........	82.500	45,100	14	20
1½ × ¾	Sh'red and an'l'd.	83,100	43,100	20	33
1 5/16 × ¾	Pl'n'd & ov'rh't'd.	82,500	43,300	25	50

It is not definitely known if the last specimens ¾ in. thick were from the same bloom as all the others. The planed specimens had ⅛ in. planed from each edge after shearing. The annealing for all specimens was done by heating to redness in a gas furnace and burying in dry sand until cool. The process seems to have been a hardening one for this grade of steel, either due to the method of cooling, or possibly the annealing temperature may have been higher than that at which the bars were originally finished. The same effect is observed in high carbon steels, unless the piece to be annealed is carefully protected from rapid cooling, or unless it is quenched at a certain critical stage of the cooling, or, as usually termed, water-annealed. The specimens, marked, planed and overheated, were raised to an ordinary working temperature or yellow heat, forming scale, and cooled in the atmosphere without further work. Contrary to anticipation, the action seemed to be rather beneficial than otherwise. This grade of steel, at least if low in phosphorus, shears and punches neatly, leaving a smoother surface than ordinary iron.

Series 8.—These tests were made to determine the effects of drifting holes in bars of a uniform width of 3 ins., having both edges sheared parallel with length of bar. The punched holes were perforated with a ¾-in. punch and 13-16 in. die, a drilled and a punched hole being cut through each bar, and drifted until fracture was visible. All edges were sheared.

Dimensions, ins.	Hole, ins.	Final diam. of hole, ins.	Fracture.
Steel 3 × 5/16..........	P'ch'd ¾	1¼	Edge of hole
	Dr'l'd ¾	1 13/32	" " "
Steel 3 × ½..........	P'ch'd ¾	1⅜	" " "
	Dr'l'd ¾	1 5/16	Edge of bar
Steel 3 × ½..........	P'ch'd ¾	1⅜	" " "
	Dr'l'd ¾	1 13/16	Edge of hole
Steel 3 × 11/16..........	P'ch'd ¾	1 5/16	" " "
	Dr'l'd ¾	1⅜	Edge of bar
Iron 3 × ⅜	P'ch'd ¾	1 3/16	" " "
	Dr'l'd ¾	1 1/16	" " "

The foregoing steel was cut from the same bars tested for tensile strength in Series 7; they can be compared by observing the respective thicknesses.

Experiments on Riveted Joints.—As the operation of riveting permanently clamps the plates together, creating a resistance to fracture of the plate independent of the force transmitted through the body of the rivet; therefore riveted joints can only be properly compared with each other, and not with tests of plates with open holes. The riveted joints hereafter described were formed by lapping the ends of two plates, and fastening them with three and five rivets respectively, as shown in Figs. 3 and 4. The object in making this imperfect joint was to obtain the distortion of the plates due to bending when pulled in the testing machine, and thus better develop the general resisting qualities of the treated plates. As the holes were quite close together, it can be seen that the differences noted between punched and reamed joints are an exaggeration of what would occur in ordinary riveted work, or joints severed by direct tension:

In Tables 7 and 8 of riveted joints, some seeming inconsistencies may be observed between the quantities given for total breaking strains and the strains per unit of net section. This arises from the fact that actual thickness and diameter of holes were properly used in estimating sections, whereas the corresponding dimensions given in the table are only nominal. Several experiments have also been made on specimens, both with open and closed holes, and submitted to transverse stress. The tests recorded herewith are typical of the series.

Six 1 sections, composed of medium grade steel plates and angles, were riveted together as shown in Fig. 5. Angles 3 × 3 x ½ ins., plates, 6 x ½ ins.; three specimens perforated 3 ins. pitch; three specimens perforated 6 ins. pitch; all rivets ⅞ in. diameter.

It can be seen that the specimens were unduly weakened by the size and position of holes. These specimens were supported 32 ins. apart and pressure applied in middle, in the position shown in cut. The load was increased until fracture began:

Average of specimens witdh, ins.,	Final pressure, lbs.	Final deflection, ins.	
Holes p'ch'd 15/16	57,600	5.78	Edge of plate and angle cracked.
Holes p'ch'd ¾ and r'm'd 15/16..	66,700	6 08	Cracked at hole at upper edge of angle.
Holes dr'l'd 15/16	68,600	6.40	Cracked at hole at upper edge of angle.

Tests of riveted joints have been made by subjecting specimens to rapid impact, supposed to produce strains above the elastic limit; but such tests are necessarily tedious, and no result worth describing has been attained. It is not necessary to summarize the results of the previous experiments on sheared edges or specimens with open holes, as shearing to the extent described is neither usual nor necessary, and the effects of punching should be considered on the riveted structure, or in the condition in which the material is put in service. In the riveted joints it will be observed that there is little difference resulting from the manner of perforation, when the plates are thin. The inferiority of punched as compared to reamed work becoming more marked as the plates become thicker. This is due partly to the least injury being done to the thin plates, and partly to the clamping action of the rivet heads hereafter described, a force which necessarily bears a greater ratio to the strength of a joint composed of thin plates than to one of thicker material.

Table 7.

Thickness and material.		Rivets.	No. of tests.	Max. load. Total	Max. load. Per sq. in. net section.	Tests of rolled bars before punching.
	ins.	ins				
6 × ¼ ins. steel	P 13/16....	3—¾	2	57,200	67,100	T. S. = 62,900
	R 13/16 ..	"	1	56.600	61,000	E. L. = 41,600
	P 15/16....	3 - ⅞	2	59,700	78.700	St. = 31,000
	R 15/16....	"	1	56,700	68,700	Red. = 58,000
6 × 5/16 ins. steel	P 15/16....	3—13/16	2	73,300	69,100	T. S. = 59,800
	P ¾.. R 15/16..	"	2	86,400	79,100	E. L. = 42,100
6 × ⅜ ins. steel	P 15/16....	3—⅞	2	78,900	73,900	St. = 34,000
	P 11/16.. R 15/16..	"	2	88,100	80,100	Red. = 61,000
6 × ½ ins. iron	P.......	"	2	71,800	46,300	T. S. = 54,300
	P and R 3/16..	"	2	90,000	56,400	E. L. = 34,800
	R ¼....	"	2	92,000	57.700	St. = 17,000
	D.......	"	2	94,900	59,500	Red. = 27,000
6 × ⅝ ins. iron	P.......	"	3	75,000	39,000	T. S. = 52,100
	P and R 3/16 .	"	2	88,500	44,000	E. L. = 31,300
	R ¼....	"	2	88,700	44,100	St. = 17,000
	D	"	1	94,300	46,700	Red. = 30,000
6 × ¾ ins. iron	P.......	"	2	74,000	30,700	T. S. = 52,800
	P and R 3/16..	"	*2	96,000	38,800	E. L. = 32,100
	R ¼ ...	"	2	94,100	38,900	St. = 20,000
	D.......	"	2	94,800	39,100	Red. = 28,000

P = Punched, D = Drilled, R = Reamed.
* Rivets sheared; in all other tests the plate broke.

Table 8.

Thickness and material, in.		Rivets.	No. of tests.	Max. load. Total.	Max. load. Per sq. in. net section.	Tests of rolled bars before punching.
6 × ½ steel	P......	5—⅞	2	113,600	74,000	T. S. = 64,800
	P. and R. 3/16..	"	2	125,100	79,300	E. L. = 39,800
	R. ¼..	"	2	126,200	80.000	St. = 30,000
	D......	"	2	119,400	75,600	Red. = 62,000
6 × ⅝ steel	P......	"	2	105,400	59,900	T. S. = 63,800
	P. and R. 3/16..	"	2	151,400	76.400	E. L. = 38,900
	R. ¼..	"	*2	150.600	76,100	St. = 28,000
	D......	"	2	148,700	75,200	Red. = 56,000
6 × ¾ steel	P......	"	2	89,800	38,800	T. S. = 64,400
	P. and R. 3/16..	"	*2	152,000	64,000	E. L. = 39,200
	R. ¼ .	"	2	154,700	65,100	St. = 28,000
	D. . . .	"	2	156,400	65,600	Red. = 54,000

* Rivets sheared, all other plates broke.

For the thinnest plates there is no diminution in the strength of the punched as compared to the reamed joint; in fact, in summing up the average result, the advantage rests with the punched joints.

It may be observed that this is not found with imperfect or loosely driven rivets. In the ½-in. iron plates the punched joints withstood 20% less strain than the average of reamed and drilled, while the ½-in. punched steel only fell about 6% below the punched and drilled. In the case of steel, however, the joint was made with a double row of rivets, whereas the iron was a single row, and the former resisted distortion from bending better than the latter case.

The ⅝-in. punched iron joints fell 13% below the reamed and drilled, and the ⅝-in. punched steel plates dropped 20% below the reamed and drilled. For the ¾-in. plates of both materials no comparison can be made, as the rivets sheared in every case for reamed and drilled holes; but drilled steel plates exceeded the punched steel plates 70% without developing the full resistance of the plate. It is probable that for steel plates of good quality, and below 80,000 lbs. tensile strength, there is no material gain by drilling or reaming over punching rivet holes, in plates ⅜ in. thick and less provided that rivets are solidly driven, or even in plates ½ in. thick if holes are not unusually close, and are not too near the edges. Above this thickness there can be no doubt of the advantage of reaming punched holes. The simplicity, economy and rapidity of the punchng process as compared to drilling, naturally commends it to both the manufacturer and the purchaser of structural material.

There is no evidence that material with drilled holes is superior to that with punched holes properly reamed, unless material is of excessive thickness, say, over ¾ in., or unless holes are excessively close together; and it is sometmes urged that there is no evidence of any physical inferiority of punched work as compared to reamed work, so long as strains are below the elastic limit, or until permanent deformation has begun; therefore, some engineers, rather than pay an increase of 10% for reamed work, prefer to put 10% increased material in punched work. It is probable that the best results combined with least expenditure can be obtained by punching all holes where vital strains are not transferred by the rivets; and by reaming for important joints where strains on riveted joints are vital, or wherever perforation may reduce sections to a minimum, such as the suspension joints of floor girders, the intersections of web members with flanges in latticed girders, etc., and all holes that have to be riveted during erection work. The reaming should be sufficient to thoroughly remove the material disturbed by punching; to accomplish this, it is best to enlarge punched holes at least ⅛ in. diameter with the reamer.

Riveting.—A series of tests were made to determine the resistance of joints riveted under different pressures. Three specimens of 3 × 1-in. flats were secured by two ⅞-in. rivets in 15-16-in. holes and compressed with pressures of 70,000, 83,000 and 110,000 lbs., respectively. The pieces were then pulled in the testing machine and extensions measured in the 9 ins. between the rivets, as follows:

Tension in lbs.	Extension in inches for joint compressed with— 70,000 lbs. pressure.	83,000 lbs. pressure.	110,000 lbs. pressure.
35,000	.03	.02	.025
40,000	.19	.085	.115
45,000	.25	.18	.17
50,000	.33	.26	.22
Final pressure and extensions when rivets sheared....	51,000 —.36	55,000 —.39	56,000 —.31

The following experiment illustrates the clamping action of the rivets. Several 6 × ⅜-in. iron plates were perforated with six accurately reamed holes, as shown in Fig. 6; one-half of the lot was riveted under machine pressure, as shown on the left; the remainder had straight pins driven into the holes, as shown to the right. They were pulled in testing machine until plates ruptured:

Diam. of holes.	Fastening.	Max. load in lbs.	Maximum load in lbs. per sq. in. Net section of plate.	Rivet section.	Bearing area.
11/16 in..	Rivets...	81,950	52,000	36,900	64,100
	Pins.	77,200	49.300	34,770	60,400
13/16 "	Rivets...	75,800	53,200	24,440	50,140
	Pins	67,600	47,440	21.790	44 700
15/16 " ..	Rivets...	73,200	57,240	17,700	42,000
	Pins.	61,500	52,000	16,070	38,150
1 1/16.. "	Rivets...	72,650	64,350	13,680	36.760
	Pins.	57,250	50,700	10,760	28,970

NEW YORK TO CHICAGO BY THE CHESAPEAKE & OHIO ROUTE.

One of the pleasantest routes from New York to Chicago, for those who have time to spare, is the southern route by way of Washington and Cincinnati, particularly if the traveler stops off at night, so as to do all his traveling by daylight. The 8 a. m. Washington express on the Pennsylvania R. R. connects at Washington with the "Washington and Chicago Special," of the Chesapeake & Ohio. Of the Pennsylvania R. R. it is not necessary to say much, since its excellence of construction and equipment are household words, but foreign engineers who travel over this road for the first time will probably get many of their ideas as to the supposed roughness of American track rudely disturbed. The train was drawn by a Schenectady eight-wheel engine, with a most aggressive extended wagon-top boiler, which only left one ring of cylinder barrel next the smokebox. The Webb (English) steel ties, which are still in use for a short length on one of the four tracks, seem to be deficient in resistance to lateral movement, as timbers are placed at intervals between the ends of the steel ties and the ends of the wooden ties of the adjacent track. Considering that even wooden ties, with their large end area, are found to shift laterally, it seems only wise that an equal area for end resistance should be provided for metal ties. The old Broad St. trainshed, which used to look so large and imposing, is now completely dwarfed by the new structure now erected above it (Eng. News, June 1, 1893). The new work is given a body color of bright red, and a finishing color of light yellow. Many improvements are being made along the Philadelphia, Wilmington & Baltimore R. R. and Baltimore & Potomac R. R. (Pennsylvania R. R.), and several changes of alinement have been made on the latter line, but much of the track of the latter line is below the standard and imparts a joggling motion to the cars.

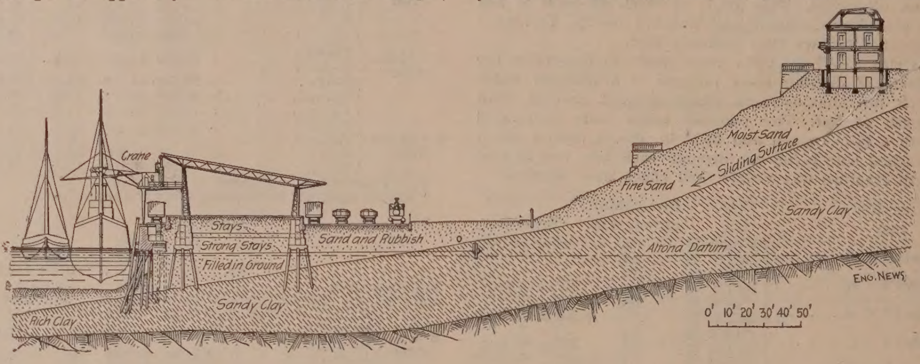
At Washington the passenger changes cars, taking a Chesapeake & Ohio Ry. train with through cars for Chicago. The day train, Washington and Chicago Limited (Eng. News, July 6), leaving at 2 p. m., consisted of a Brooks 10-wheel locomotive, mail car, baggage and smoking car, day car, dining car and Pullman sleeping car. Two more cars were added from Richmond. The day car was very comfortable, and was fitted with toilet-rooms and lavatories. It was lighted by electricity, the main part of the car having four incandescent lamps along each edge of the monitor roof. The lamps had short wires which were very steady. The car seated 56 passengers. The interior was finished in mahogany, with dark green plush upholstering, natural wood headlining, and matting on the floor of the aisle. A porter is in charge of each car. The track is very easy riding. Passengers wishing to go over the entire route by daylight can comfortably stop off at Clifton Forge, Va., where the Chesapeake & Ohio Ry. Co. is operating the Gladys Inn as a summer resort. The next day at 5:55 a. m. one can take the Fast Flying Virginian express (leaving New York at 5 p. m.) and travel over the Chesapeake & Ohio Ry. through the magnificent mountain and river scenery and along the Ohio River to Cincinnati, which is reached at 6:25 p. m. There is a considerable amount of double track, well ballasted with slag or broken stone, and laid with heavy rails and six-bolt angle bars. Many improvements are being made along the line. The train consisted of an express car, mail car, baggage and smoking car, day car, three sleping cars and a dining car. The day car had a smoking-room, closets and lavatory, but the latter was not provided with towels, a most provoking omission (which the conductor was unable to remedy), as the smoke and dust of travel added to the smoke from the numerous coke ovens make the route a somewhat dirty one, especially in hot weather when all windows are open. The train was lighted by electricity.

From Cincinnati the route to Chicago is by the Kankakee line (Eng. News, July 22), the Cleveland, Cincinnati, Chicago & St. Louis Ry. to Kankakee, and Illinois Central R. R. to Chicago. By stopping off at Cincinnati for the night, one takes the Washington and Chicago Special again at 8:02 a. m., arriving at Chicago 5:15 p. m., and the trains were very punctual throughout the trip. The day cars were vestibuled, but the vestibules were not fastened together, so that there was a most distressing squeaking and shrieking of the face plates as they slid from side to side. The usual hot box materialized and a badly cut brass was removed at Indianapolis. The track is easy riding. At Kankakee an Illinois Central R. R. engine takes the train, and this engine, like most others around Chicago, smokes as furiously within the Chicago city limits as though such a thing as a smoke ordinance did not exist. In fact the ordinance appears to be of very little avail. The four main tracks have the Hall automatic signal system, the "banjo" boxes being erected on light iron bridges spanning the tracks. The signals look odd and unfamiliar, particularly as the familiar semaphore signals are provided for switches, and as the automatic signals are normally at "track clear" and the semaphores normally at "track blocked," the arrangement has a complicated appearance. Where the tracks are elevated they cross the streets by plate deck girders with transverse V-trough floors, but the troughs do not fit against the girders, gutters being placed under the connections to catch rainwater. Small ties are placed in the troughs and no ballast is used. The thunderous sound caused by trains crossing these bridges suggests the desirability of introducing a sound insulator, as is proposed for the Park Ave. viaduct, in New York (Eng. News, May 25, 1893). The new Twelfth St. terminal station of the Illinois Central R. R. has a pleasing appearance, but the interior work is not yet completed.

A ride on the South Side elevated railway appears familiar to a New York man, but the trains are not handled well at stations, as they jerk violently with frequent applications of the Westinghouse brake to stop at the right place, and even then the car platform gates are very often fouled by the railings on the station platforms. The speed is slow and the lurching at curves, etc., worse than in New York. The end doors of the cars are double, but with the experience of the New York roads before them it is strange that the designers did not make longer platforms, as the crush at the narrow gates is wholly unnecessary. The cars are lighted by Pintsch compressed gas, but the bright yellow of the lamps does not accord with the interior finish and bronze fittings of the cars. The cars are painted a greenish yellow on the exterior, and the engines (all Baldwin four-cylinder compounds) have cabs, tanks, etc., a dark bottle green with a little yellow striping.

RE-ENFORCING A DEFECTIVE QUAY WALL, ALTONA, GERMANY.

An interesting description of the method adopted to re-enforce a defective quay wall at the port of Altona, Germany, was given by Mr. Berthald Stahl in a paper presented at the recent International Engineering Congress at the World's Columbian Exposition. This wall was 1,804 ft. 6 ins. long, and was constructed, as shown in Fig. 1, at the foot of a slope rising about 105 ft. in a distance of 1,640 ft., on which a portion of the town of Altona is built. The soil of this slope consists of a layer of fine sand resting on a bed of firm clay, which becomes very slippery when wet. As long as the water is permitted to percolate freely through the upper layer of sand there is no danger, but as soon as it is confined the clay becomes wet, and landslides are caused. In building the quay wall these facts were not known or else not considered dangerous to its stability.



SKETCH SHOWING METHOD OF RE-ENFORCING DEFECTIVE QUAY WALL

The wall is built of hard brick, with cement mortar, and is supported on a pile foundation, as shown in the cut. Its front part is solid, and it is backed at intervals of 29 ft. 6 ins. by buttresses, between which are two arches, one above the other. At the rear of the pile foundation is a row of sheet piling, as shown, and the wall and its foundation thus acted as a retaining wall for a considerable mass of earth loaded by the sheds, etc.

Some time after the completion of the wall cracks appeared, indicating that it was failing. At the same time cracks appeared in the solid gable walls of the sheds running at right angles to the quay wall. As the sheds had a separate foundation, it was concluded that the appearance of the cracks in both them and the quay wall simultaneously indicated that the whole mass of earth had moved forward. The backing of the wall was at once removed, and the front foundations of the shed secured to the rear foundations by iron ties. This served to prevent any further movement of the sheds. Observations were then made to determine the cause of the movement. It was found that the wall had a pendulum-like movement around a point of the piles, indicating that the bottoms of the piles penetrating the clay did not move, but that the upper layer of sand by moving caused their tops and the wall to swing, as noted. In addition, after a long series of observations, it was found that the whole mass of earth above the layer of clay from the top of the hill down was moving toward the water, and consequently moving the wall outward.

It was decided to first prevent the pendulum-like movement of the wall, and to this end iron ties were carried back from the face of the wall or foundation piles and fastened to wooden shields 8 ft. 2½ ins. square, embedded vertically in the clay some distance to the rear of the sheds. At the face of the wall these ties were fastened to a waling of two beams. To place the ties, ditches 4 ft. 11 ins. wide, and 16 ft. 5 ins. deep were dug parallel to each other 14 ft. 9 ins. apart, and perpendicular to the face of the wall. Then a ditch 16 ft. 5 ins. wide was dug parallel to the wall about 164 ft. back from its face, into which the first ditches opened. This last ditch was for placing the shields. There were 29 ties in all, each made up of 16 ft. 5-in. links, consisting of alternate one round bar 3.15 ins. in diameter and two flat bars of equal strength to the round bar, fastened by a bolt through eyes at their ends. The ties were tightened by screws at the rear of the shields.

Since the confining of the surface water at the rear of the wall had caused the first trouble it was necessary to provide for the drainage of the soil. This was done by filling the bottoms of the ditches dug for the ties with broken brick and arching them over above the ties. Suitable pipes were provided in the wall for the discharge of the water.

The next step was to strengthen the quay wall proper. It was found that the arches between the buttresses had been destroyed, and owing to the displacement of the wall it was considered inadvisable to renew them. At the same time, it was necessary to provide a foundation for the track just back of the wall. The soil just behind the wall was consequently removed and the space filled with broken bricks, and on the top of this another lean concrete wall built. The space between the concrete wall and the old brick quay wall was bridged by iron I-beams placed 5 ft. 10 ins. apart. Between these I-beams were built concrete arches.

The quay wall has now been opened for traffic, and thus far no further disturbance noticed. The cost of renewing the quay was 275,000 marks ($64,625), or 2,000 marks ($470) per lineal meter (3.28 ft.).

THE CHICAGO DRAINAGE CANAL.

The Chicago Drainage Canal, now under construction, was visited on Aug. 7, by a large number of the American and foreign engineers, who had been in the city attending the International Engineering Congress. The trip was by invitation of the Board of Trustees of the Sanitary District, and several members of the Board accompanied the party which party filled a special train of seven passenger cars, while a baggage car contained the refreshments. The trip was over the Atchison, Topeka & Santa Fe R. R., and stops were made at frequent intervals. On the earth sections two methods of disposing of the material were seen. In one place a Bucyrus steam shovel was unloading into dump cars which were hauled away by locomotives to form a bank or levee on the division of the Des Plaines River. In another place a Barnhart steam shovel was loading large end dump cars which were hauled by cable on a track at right angles to the line of the canal and up a steep trestle with a dumping platform at the end, 30 ft. above the ground, the muck being dumped to form the commencement of a bank on which tracks for ordinary dump cars can afterward be laid for widening. On the rock sections the channeling and drilling were watched with interest, as well as the different methods of hauling the material, and a large blast was exploded. Besides the ordinary handling of material by dump cars hauled by mules and cables, there are three styles of conveyors employed. One of these is the Brown conveyor, consisting of a central tower with cantilever arms on which run large skips which are raised and lowered at any point. The conveyor runs on a track alongside the canal, with one end of the arm inclined down over the cut and the other end elevated over the dump. Another type is somewhat similar in operation, but of a different pattern. Lidgerwood cableways are also in effective use. Work is being vigorously prosecuted, and many of the foreign engineers expressed their astonishment at the extent of the work, the great aggregation of plant and the rapidity with which the work is carried on as compared with European practice. At Lemont a stop was made for lunch, which was served on the train, and brief addresses were made by Mr. Metcalf, President of the American Society of Civil Engineers; Mr. Frank Wenter, President of the Board of Trustees of the Sanitary District; Mr. L. E. Cooley, one of the Trustees and formerly Chief Engineer, who referred to the importance of the canal for navigation as well as sewerage; and Mr. Ossian Guthrie, who has made a careful study of the geology of the district traversed by the canal. Mr. Guthrie's remarks were of considerable interest and were substantially as follows:

> We are now standing upon the bank of the 12-mile level of the Des Plaines River, 600 ft. above tidewater, the glacial outlet from the Lake Michigan basin and not its ancient outlet except for a very limited period in glacial time. It is estimated that within a distance of 45 miles along this valley 500,000,000 cu. yds. of rock have been excavated by glacial action, 20,000,000 to 30,000,000 of which remain to attest the manner of excavation. Until the recent investigations in relation to the drainage channel this work was attributed to water action. This valley, the valley of the Illinois properly, which extends from Lake Michigan to the Mississippi, a distance of 325 miles, is the grandest glacial pathway on the continent. Here, where we now stand, the Lake Michigan stream passed it. About 40 miles below here the Kankakee, or more properly the Saginaw stream, entered it. At Ottawa, the Marquette and Green Bay streams entered, and between the Kankakee River and Alton a number of small glacial streams from Lake Erie and the Wabash Valley. These were the prairie makers of Illinois. It is estimated that these glaciers had swept over an area of 750,000 square miles and gathered and incorporated within themselves representatives of every geological formation within that area, to be distributed over Illinois. Each of these principal streams contained, and distributed along its course, something peculiar to itself, and the aggregate variety of their contributions to Illinois probably exceeds that of any equal area on the globe. It comprises the entire geological formation from the Potsdam sandstone to the surface, and every variety in that broad area capable of enduring that destructive mode of transportation. Within five miles of this point, on Lane's Island, is a granite boulder of recognized Canadian origin, which measures 27½ ft. around and stands 5 ft. above the surface of the ground. Within a half-mile of this boulder a thousand or more smaller boulders may be seen. Every granite boulder in this region is of Canadian origin.

REQUIREMENTS IN MATHEMATICS FOR ENGINEERING EDUCATION.

The following is an abstract of a paper by Arthur N. Talbot, Professor of Municipal Engineering, University of Illinois, presented Aug. 1 before Section E, Engineering Education, of the Congress of Engineering, the proceedings of which Congress are given in this issue:

The aims of engineering education are as follows: 1, General development; 2, trade school training; 3, professional training.

As to the part taken by mathematics, the disciplinary value to the average student may have been overestimated. The training in a working knowledge of the elements, in rapidity and accuracy, for routine engineering work—the trade application—is usually insufficient. The value in professional training is perhaps greatest, as it has a large value as preparatory to the presentation of technical studies. A prolonged study of mathematics may cause the engineer to misdirect and misappropriate his efforts.

The accompanying table shows the relation between pure mathematics and the entire course of 12 engineering schools. The usual admission requirements are arithmetic, algebra through quadratics, plane and solid geometry and in one case trigonometry. Advanced algebra, plane and spherical trigonometry, analytical geometry, and calculus are always prescribed. About 11 to 14% of the entire course is usually devoted to these. Considerable unanimity in time and subject matter is shown by this table.

In methods and results the conclusion is that all these branches are economically necessary, and that the time spent is not extravagant. Engineers fail to appreciate the usefulness of mathematics. There is some force in the criticisms that the results obtained in students are not what might be expected.

In the way of suggestions it may be said that it is not how much, but how well, to treat the subject. Treat little beyond the elements, and drill the student so that he may use mathematics as a tool. Illustrate and apply. Give problems, engineering problems, and avoid confining the training to exact and purely theoretical conditions. Correct and grade the student's work, as hard drilling is an element of success. Teach relative accuracy. Instructors in the succeeding technical subjects have a great opportunity for extending, strengthening and fixing the student's mathematical equipment, and too much importance cannot be placed on this drill.

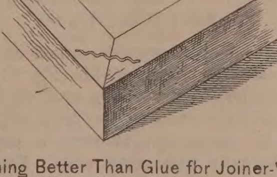
Table showing Relation between Time Given to Pure Mathematics and that Devoted to the Entire Course in Twelve Engineering Schools:

	Course.	Admission requirements.	Mathematics in course.	Total No. of exercises.	Total in mathematics.	Per cent. in mathematics.	Per cent. in calculus.
Mass. Inst. Tech..	C. E. M. E.	1, 2, 3	4, 5, 6, 7, 8, 9	2,380	260	10.9	3.6
Cornell U.........	C. E. M. E.	1, 2, 3, 4	5, 6, 7, 8, 9	2,328	290	12.5	5.2
Lehigh U.........	C. E. M. E.	1, 2, 3	4, 5, 6, 7, 8, 9	2,454	324	13.1	4.1
Worcester P. In..	C. E. M. E.	1, 2, 3	4, 5, 6, 7. 8, 9	2,920	356	12.2	3.3
U. of Michigan...	C. E. M. E.	2, 3, 4, 5	7, 8, 9	2,125	285	13.4	8.0
U. of Illinois......	C. E. M. E.	1, 2, 3, 4	5, 6, 7, 8, 9	2,556	360	14.1	6.1
U. of Wisconsin ..	C. E. M. E.	1, 2, 3, 4	5, 6, 7, 8, 9	3,008	360	12.0	4.6
U. of Minnesota..	C. E. M. E.	2, 3, 4	5, 6, 7, 8, 9	2,844	300	10.5	4.2
Purdue U.........	C. E. M. E.	1, 2	3, 4, 5, 6. 7, 8, 9	3,000	472	15.7	3.8
U. of California..	C. E.	1, 2, 3	4, 5, 7, 8, 9	2,339	352	15.0	3.2
U. of California..	M. E.	1, 2, 3	4, 5, 7, 8, 9, 10, 11	2,339	501	21.1	3.2
Stanford, Jr., U.	C. E M. E.	2, 3	4, 5, 6, 7, 8, 9	2,040	408	20.0	5.0
Washington U....	C. E. M. E.	2, 3, 4	5, 6, 7, 8, 9	2,807	337	11.8	5.1

1. Arithmetic. 2. Algebra. 3. Plane geometry. 4. Solid geometry. 5. Plane trigonometry. 6. Spherical trigonometry. 7. Advanced algebra. 8. Analytical geometry. 9. Calculus. 10. Least squares. 11. Differential equations.

A LABOR-SAVING INVENTION FOR PATTERN SHOPS.

A corrugated nail is a recent novelty which is proving a great factor in saving labor in pattern shops and other woodworking establishments. The accompanying cut will make the invention clear. The "nail" resembles the ordinary nail only in being made to drive into wood with a hammer. It is simply a piece of corrugated sheet steel about 1-50 in. thick, ¾ in. wide and of various lengths, according to the thickness of the pieces which it is desired to join together. Where two pieces of wood are to be fastened together this is placed at right angles to the joint and driven in flush with a hammer. The corrugations cause the wood to hold it firmly and a joint can be made as strong as the ordinary joint held by glue and screws in a very small fraction of the time. Its value in pattern shops comes not only from its great saving of labor, but from the fact that a pattern can be put together for a rush order in far less time than if glue were used, and is then ready for use without a tedious delay for the glue to dry. The invention is also finding extensive use among cabinet-makers, carriage-builders, furniture-makers, etc. Messrs. Pratt & Letchworth, of Buffalo, N. Y., are the makers of these corrugated nails.



Something Better Than Glue fbr Joiner-Work,

ABSTRACTS OF PAPERS PRESENTED AT THE INTERNATIONAL ENGINEERING CONGRESS.

(Continued from page 110.)

Transmission of Power in Operating Cable Railways.

This paper, by Mr. Robert Gillham, M. Am. Soc. C. E., gave a very interesting series of experiments made in Kansas City, Mo., Cleveland, O., Denver, Colo., and Chicago, Ill., to determine the efficiency of the several methods of transmitting power on cable railways under varying conditions of traffic and weather. Taking the several tests in order the following are brief statements of some of the more important points brought out:

Kansas City Ry.—The cable tested at Kansas City was 22,000 ft. long, operated by a 24 × 48-in. cylinder Wright engine. The diameter of the cable is 1¼ ins. and its speed 7.03 miles per hour. There are two right angle curves on the line, each of 55-ft. radius. Commencing at the western terminus of the line, there is an elevated waiting-room above the street, then a level piece of track for a distance of about 250 ft., then a 19% ascending grade on an elevated steel structure, which extends to the summit of a high bluff, a distance of about 1,000 ft. From the summit a 10% descending grade for a distance of 350 ft. reaches the power station. The grades from the power station all descend to Main St., where an ascending grade of 15% occurs for one block, then a grade of 10% for one block, where a right angle curve is located. One block from this curve another similar curve occurs. The other grades vary from a level to 8%.

It was found that the mean power required to propel a grip car and one closed car, with passengers was 4½ HP.. The grip car empty weighed 4,800 lbs., and the passenger car, empty, 4,000 lbs., the weight of the passengers being unknown. The mean resistance of the engine and main line shaft, as developed by these tests, was equal to 16.41 HP. The lowest resistance noted was 12.24 HP., and the highest 21.12 HP. The variation of the resistance of engine and shaft was largely due to the friction clutch on the main shaft, whose plates must have been slightly in contact, thus producing brake action. These clutches form part of the pinion on the main shaft, and were used for the purpose of communicating power to the pinion and thence to the driving drums. One set of these driving drums usually requires 5 HP. to operate them, without cable. The mean power developed in operating the cable without cars, machinery and engine was 37.24 HP. The mean percentage of total power developed and required to overcome resistance and operate the engine and main shaft was 17.11%. The mean percentage of total power developed to operate the cable and machinery was 38%. The mean percentage of total power developed to propel cars, with passengers, was 44.4%, which leaves 0.45 of 1% unaccounted for, due probably to slight errors. The tension on the cable was observed to vary, depending directly upon the position of trains and condition of traffic. The minimum stress on the cable was secured when six trains were operated. The maximum stress, with this number of trains, was 8,350 lbs.; the mean stress 3,804 lbs. The maximum stress was observed when 13 trains were operated; with this number of trains the maximum stress was 18,980 lbs.; the mean stress 6,270 lbs.

Cleveland City Ry.—The Cleveland engines are Wright automatic, with 38×60-in. cylinders and making 64 revolutions per minute. They are connected directly with the main shaft placed between the driving drums. All the cables are 1¼ ins. in diameter and weigh 2.6 lbs. per lin. ft. The following table gives the results of the tests made on five different lines:

Name of cable.	Length of cables, ft.	Speed of cables miles per hour.	H P. required for cables.	H-P. required per lin. ft. of cable.	Remarks.
E. Superior St..	23,900	14	78.43	0.00328	No curves.
W. Superior St.	24,300	12	6'.25	0.00252	No curves.
E. Payne Ave..	25,300	12	144.13	0.00569	Four right-angle curves.
W. Payne Ave.	24,050	12	56.11	0.00233	No curves.
Water St. Aux.	7,850	4	14.50	0.00184	One right-angle curve

To determine the brake action of the friction clutches separate tests were made. These gave results as follows:

Test.	Load.	Ind. H. P.	Length of cables ft..
1	Engine and line shaft only.	143.65	
2	Engine, line shaft and E. Superior St. cable only...	173 51	23,900
3	Engine, line shaft and W. Superior St. cable only. (auxiliary cable)..........	141.50	24 300
4	Engine, line shaft and W. Payne Ave. cable only...	158.93	24,050
5	Engine, line shaft and E. Payne Ave. cable only....	184.44	25,300
	Total....................	802 03	
6	All cables in operation and 30 trains or 64 cars in operation......................	509.56	
	Difference...	292.47	

Referring to these tests the author says:

> It will be seen that the sum of the horse-power of the individual tests of each cable is 802.03 HP. Test No. 6 gives the actual power required to operate all the cables with 30 trains and their loads as 509.56 HP., which is correct, as the clutches when all thrown in could not exert brake action. The difference between these amounts is the brake action, 292.47 HP. It is needless to say that in many tests this brake action of the clutches has not been noted, and the world is informed that the resistance of cable machinery is too high, and no considerable economy can be secured in the operation of cable railways.

Denver City Cable Ry.—The Denver cable railway system is, perhaps, the largest single cable plant in the country; that is, there are more miles of cable railway operated from its power station than from any other single power station in the world. Cotton rope transmission from the engine to the main shaft is used. The engines are automatic cut-off engines, two in number; cylinder, 36 ins. in diameter; stroke, 60 ins.; engine shaft, 20 ins. in diameter; flywheel, 20 ft. in diameter, weighing 125,000 lbs. Revolutions per minute, 56.

After considerable experimenting and careful testing, it was assumed that on this road the power required to operate various special parts of the cable railway was as follows: One 90°, 55 ft. radius, double-track curve, 20.64 HP. One 45°, 55 ft. radius, double-track curve, 10.34 HP. Elevating and depression and let-go sheaves, 0.503 HP. Each linear foot of cable, straight track, for cable only (not including engine and machinery resistance), .001612 HP. Applying these factors in the computation of power required for the cables in question, and comparing the results with the results secured by actual test at a later date, gives the following:

Name of line.	Length of rope. Ft.	Theoretical power. H. P.	Actual power. H. P.	Power unaccounted for. H. P.
Larrimer St......	23,100	60.352	126.297	65.945
Sloan's Lake.....	31,250	77.514	100.54	23.023
Seventeenth St..	11,850	26.647	27.827	1.18
Welton St........	36,850	133.001	208.738	75.727
Seventeenth Ave.	25,297	73.187	74.195	1.008
No. Denver.......	25,271	52.539	53.595	1.056
Totals..........		423.270	591.192	167.942

The difference between what is given as the theoretical test (deductions from experiments), and the power actually developed in the tables, is an evidence of defective machinery.

Chicago City Ry.—Tests were made at two power stations, one at Fifty-fifth St. and the other at Twenty-first St. The former consists of two Wheelock automatic engines, 36×72 ins., operating four cables having a total length of 59,700 ft. The cables are driven at a speed of 13.76 miles per hour. The total power required to operate all the cables and the machinery without cars is 382 HP., or 0.0064 HP. per lin. ft. The maximum tension on the cables during operating hours, when travel was at the maximum, equaled 10,420 lbs., or a pull of 0.175 lb. per lin. ft. of cable. In order to determine the actual work performed and the load on the cables when the cars were in operation, a series of cards were taken from the engines, and from an examination of time-tables and trip-sheets of conductors the loads on cables were approximated. The following gives the result of such tests, based on the indicator cards selected:

Mean powers (maximum), less power to operate empty cables....................	257 HP.
Mean load on cables.....................	152.7 tons.
Mean net power per ton of load on cables (maximum)......	1.68 HP.
Mean power of maximum cards...........	339 "
Mean power of all cards, less power to drive empty cables......	138.5 "
Mean power per ton of load, less power to drive empty cables....	0.91 "
Mean power (maximum cards) per ton of load on cable......	3.77 "
Variation in horse power per ton of load on cables..	1.55 "

Similar tests were made at the Twenty-first St. power station. Engines, two in number; cylinder, 30 ins. in diameter and 60-in. stroke; same type of engine as is used in Fifty-fifth St. station.

These tests were made to determine the power developed during the hours of maximum travel during the morning, with the view of making comparisons with the other tests at Fifty-fifth St. station.

Mean power of maximum cards................	642.4 HP.
Mean of maximum powers, less power to drive empty cables...................................	384.4 HP.
Mean load on cables.........	813 tons.
Mean of maximum powers per ton of load......	.428 HP.
Mean power of minimum cards..........	483.
Mean power per ton of load, less power to drive empty cables...:.....................	0.330 HP.
Mean power during tests, less power to drive empty cables...........................	268.74 HP.
Mean of maximum powers per ton load on cables	.792 HP.
Variation of power per ton of load on cable.....	.196 HP.

Tests were also made to determine the power required to operate the cables at varying speeds. The first test at Fifty-fifth St. developed the fact that the pull per foot of cables, including engine and machinery resistance, was .175 lb., and that made at Twenty-first St. station was .215 per lin. ft. of cable. The last test at Fifty-fifth St. station demonstrated that the pull equaled .137 lb. per lin. ft. of cable, at a speed of 13.76 miles per hour, and .119 lb. at a speed of 13.76 miles per hour, and .119 lb. at a speed of 9.65 miles per hour. The first test was made when starting the cables in the morning, before any of the bearings were thoroughly warmed and lubricated. The last tests were made at night, after operating hours, and immediately after the cars had been taken off the street. Thus the midnight test offered the most favorable conditions.

An Improved Method of Constructing Foundations in Sand Under Water.

In a paper on an improved method of constructing foundations under water, Mr. Fr. Neukirch described a method of converting sand into sand concrete by forcing cement in the form of powder, as it occurs in commerce, through a pipe by air pressure, into the submerged sand. The pipe has an internal diameter of about 1½ ins., and is drawn to a point at the lower end, in which there are three or more holes of about ⅜ in. diameter. The upper end is connected by a bend and rubber tubing with the air-pressure supply pipe in such a manner that the pipe can be raised, lowered and moved while the air pressure is flowing through it. In the air-pressure supply pipe, provision is made by means of suitable branches and stopcocks for connecting an apparatus which by means of an injector device enables any desired quantity of cement powder to be fed into the air current. The air pressure, together with the cement powder, issues through the small openings at the lower end of the lance pipe, and is driven with considerable pressure into the sand foundation; this is very mobile as it is entirely under water, and consequently the blowing in of the cement produces a motion in the foundation pit similar to that in a vessel of boiling water, the steam bubbles instead of air bubbles being formed. The cement carried by the air is retained by the wet sand and combines with this to form sand concrete.

By the boiling motion an intimate mixture of the wet sand with the cement is effected. After the injection of air has ceased, the grains of sand in subsiding adhere very firmly together, and experiments have shown that a natural bed of sand, after having one-fifth of its volume of cement injected into it, will, after the operation, occupy a smaller space than before; this was shown by the fact that the surface of the sand concrete lay deeper than that of the surrounding natural sandbed.

The introduction of the lance tube into the sandbed is effected by first blowing air through it, so that the air issuing from the lower end forces back the sand and in setting it in motion renders the sinking of the tube to considerable depths, such as 16 to 19 ft., readily possible in a comparatively short space of time; this operation is rather more difficult when the bed is not purely sand, but contains larger stones, wood, etc. In this case it may be necessary to raise the tube up again and to insert it at a different place so as to avoid the obstructions.

In order to insure a uniform mixture in the foundation pit, it is divided into small fields of from 8 to 12 ins. square, and into each of these the required quantity of cement, which is ascertained by dividing the cubic contents of the field by the required proportion of the admixture, is blown. The lance tube is first sunk in each field down to the solid substratum by means of air pressure alone, when it has attained this depth, cement is supplied to the air current, and during the continued introduction of the cement powder the tube is slowly drawn upward until the required quantity of cement has been introduced.

General Engineering Classification and Index.

The object of this paper by Mr. Wm. L. Chase, of Worcester, Mass., is the laudable one of inducing engineers to adopt some system of classification for convenient use of the numerous notes, newspaper clippings, trade catalogues, books, periodicals, etc., etc., which are always accumulating in an engineer's office, but which are often thrown away or allowed to lie around in promiscuous heaps difficult to get at and become, therefore, comparatively useless, although they contain very much useful matter. For this purpose the author advocates the well known Dewey Decimal System for libraries. This system consists, in brief, in arbitrarily dividing the whole field of knowledge into nine classes, represented by Arabic numerals in hundreds place, as:

Philosophy, 100; Religion, 200; Sociology, 300; Philology, 400; Natural Science, 500; Useful Arts, 600; Fine Arts, 700; Literature, 800; History, 900; Cyclopaedias, Periodicals, etc., too general in character to fit any of these classes, make a tenth class marked 000. Each class is divided into nine or less divisions, and each division into nine or less sections, represented respectively by the numerals in tens and units places. Subdivision is further carried out decimally to such an extent as may be necessary to define any desired minute classification of a subject. Naught in each place, division, section, etc., holds its normal power, and signifies that the material so marked is too general to be subdivided.

To index and file an item, it is marked with its classification number and placed in the numerical order thus indicated in the collection which it joins. To find an item, the subject index is consulted for the classification mark, which gives the numerical place in the collection of all the items the collection contains under the head sought. The items under each head may be arranged alphabetically by authors or titles, and, if the collection is large enough to require it, the items may be alphabetically indexed under any head, though generally the items themselves, properly arranged, furnish their own index.

PERSONALS.

Mr. D. A. Reed has been re-elected City Engineer of Duluth, Minn.

Mr. E. Randolph has been appointed General Superintendent and Chief Engineer of the Chesapeake, Ohio & Southwestern R. R.

Mr. Wiliam M. Green has been appointed General Manager of the Cincinnati, Hamilton & Dayton R. R., with headquarters at Cincinnati.

Mr. Thomas D. Messler, Third Vice-President of the Pennsylvania R. R. and of the Pittsburg, Cincinnati, Chicago & St. Louis Ry., died at Cresson Springs, Pa., on Aug. 11. Mr. Messler was for many years President of the St. Louis, Vandalia & Terre Haute R. R. and had held many other railway offices.

Mr. Charles G. Otis died at his home in Brooklyn, on Aug. 7. He was born in Troy, N. Y., in 1831, and in 1861, in company with his brothers, began the manufacture of passenger and freight elevators. In 1874 they founded a company under the name of Otis Brothers & Co. and erected a large factory at Yonkers, N. Y., and another in Chicago. Mr. Otis was always an active member of the company and made several valuable inventions.

Capt. E. H. Kirlin died at his home in Washington, D. C., Aug. 11, at the age of 64 years. Captain Kirlin served in the Union army throughout the war, and was afterward connected with the development of Southern railways. From 1876 to 1884 he was Government Inspector on the Kanawha River improvement in West Virginia, and superintended the erection of the first movable dam built in this country after the model of those built on the Seine, below Paris.

NEW PUBLICATIONS.

POCKET-BOOK OF USEFUL FORMULAE AND MEMORANDA FOR CIVIL AND MECHANICAL ENGINEERS.—By Sir Guilford L. Molesworth, M. Inst. C. E., and Robert Bridges Molesworth, M. A. Cantab., Assoc. M. Inst. C. E. Twenty-third edition, revised and enlarged. London: E. & F. N. Spon, and New York: Spon & Chamberlain, publishers. 16mo; 781 pp.; $2.

This pocket-book has been before engineers for 30 years or more, and needs no introduction as to its many excellent features. The edition first published is brought up to date and many new notes and tables are introduced.

ECONOMIC LEGISLATION: The Law of Incorporated Companies Operating Under Municipal Franchises, such as Illuminating Gas Companies, Fuel Gas Companies, Electric Central Station Companies, Telephone Companies, Street Railway Companies, Water Companies, Etc.; Preceded by a Suggestive Discussion of the Economic Principles Involved in the Operation, Control and Service of Such Companies. By Allen Ripley Foote, Author of "Economic Value of Electric Light and Power," and Charles E. Everett, Editing Attorney, with a Resident Attorney in Each State as Co-Editor. Cincinnati: Robert Clarke & Co. 8vo; sheep; 3 vols.; pp. 2,930, including an index of 470 pp., comprising Vol. III.

The rapid growth of companies operating under municipal franchises during the last decade or two has made a work on the plan of the one under review almost a necessity to many promoters and members of the legal profession and to others having to do with the granting of franchises to, or the enactment or interpretation of laws regarding corporations performing municipal functions. This work seems to have been admirably planned and carried out and is its own evidence that a vast amount of time from many workers has been put upon it. The magnitude and expense of the work have so increased since its inception that three volumes instead of one have been necessary and instead of an expenditure of a few thousands of dollars an outlay of over $40,000 has been incurred.

Aside from the introductory chapters by Mr. Foote and Mr. Everett, the former dealing in an abstract way with the economic questions, and the latter with the general legal questions involved, the scope of the work is to present in as compact a form as possible, for eact state and territory, the history and present status of corporations acting under municipal franchises and the experience and possibilities of the municipalities of such states regarding municipal ownership of public works. It will be understood that the work does not deal with individual private corporations or cities, except by way of illustration, but with the general laws of each state and the common experiences within it. Statutes and court decisions are cited freely and an alphabetical index of cases occupies about 60 pages, and the same space is devoted to a general review of United States and State Reports and an index of reports and reporters. Ordinances of 12 of our largest cities, either granting franchises or relating in a general way to such operations, are also presented.

The nature and extent of the work renders a more extended notice impracticable and unnecessary. Enough has been said to convey a general idea of its apparent completeness and value.

HANDBOOK OF RAILWAY PUBLICATIONS.—Compiled by S. Cotterell. Birmingham, England. Edward Baker. 16mo; pp. 128. Price, 25 cts.

This is a list of various publications, documents and charts connected with the rise and development of the railway system, principally in Great Britain and Ireland, with the prices at which they are for sale. The list is arranged by subjects and dates, and some interesting notes are given on the contents of the various books.

MONTHLY RECORD OF SCIENTIFIC LITERATURE: June 15, 1890, to June 15, 1893, inclusive. New York. D. Van Nostrand Co., 8vo., pp. 152.

The "Monthly Record" contains information regarding new and old scientific works, with special bibliographies and with outlines of the contents of the more important books.

THE PROPER PROTECTION OF THE PUBLIC RIGHTS AND INTERESTS INVOLVED IN RAILWAY COMMERCE.—An address before the Railway Congress Auxiliary of the World's Columbian Exposition, by Hon. W. G. Veazey, Interstate Commerce Commissioner. The Railway Review; Chicago; pamph.; pp. 24.

STANDARD STEEL CONSTRUCTION: A Manual for Architects, Engineers and Contractors, Containing Useful Tables, Formulas and Other Information Respecting Beams, Channels and Structural Shapes. Arranged by J. M. Larimer. Pittsburg and Chicago, Jones & Laughlins, Ltd. 12mo., tucks, pp. 215, $2.

This is an admirably arranged pocket-book, giving, besides the sections of steel and iron rolled by the Jones & Laughlins mills, a large number of tables prepared for convenient reference by the structural designer. Considerable space is devoted to the Larimer steel column, invented by the compiler of the book, and one of the specialties of the firm. A report of tests of three columns is given, one 7 in., one 8 in. and one 9 in. The 7-in. column was 10 ft. in length, and failed under a load of 37,393 lbs. per sq. in. of cross-section. The other columns gave results in harmony with this. Tables of loads for these columns, spacing of steel beams, different forms of fire-proof construction, strength of beams, girders, angles and channels, areas and circumferences of circles, logarithms, trigonometric functions and weights of various structural material, form a part only of the contents of this very complete pocket-book. We note with interest the firm's announcement in the preface that they have discontinued the manufacture of iron beams and channels, as "all engineers and architects who have kept pace with the times appreciate the advantages of steel and adopt it for all work of any magnitude in preference to wrought and cast iron."

POOR'S MANUAL OF RAILROADS. 26th Annual Number. New York, 1893; H. V. & H. W. Poor; 8vo., cloth; maps; pp. 1,236 in manual proper and 208 in directory of officials. Price, $6.

We have already reviewed the principal features of this issue, and the book is so well known to most of our readers as to make any further notice unnecessary. One point which we may note. as it is in many respects an improvement in convenience, is the collection of the various maps side by side in the front part of the volume, where they can be referred to without searching through several hundreds of pages of other matter, as was necessary in former issues.

REPORT ON THE STATISTICS OF RAILWAYS IN THE UNITED STATES, for the year ending June 30, 1891. Pub. Doc.; 8vo; cloth; pp. 655; index.

A full discussion of the principal features of this report is given in this issue and the issue of Engineering News for Aug. 3.

LIDGERWOOD MANUFACTURING COMPANY.—Cableway Sketches, illustrating approved Hoisting and Conveying Devices Employed in Constructing Dams, Piers, Walls and Sewers, and for Open-Pit Mining, Quarrying, Logging, Handling Coal or Packages. 96 Liberty St., New York. Oblong. 60 pp.

This newest issue of the Cableway Sketches, illustrates by excellent sketch and detail drawings from photographs, the many applications of cableways to engineering work. They record actual work performed under many varying conditions, give the dimensions, and, in many cases, the capacities. We recommend it to all having work of this nature on hand.

LOCAL ENGINEERING DATA FOR ST. LOUIS.—Compiled by the Engineers' Club of St. Louis. 12mo; 55 pp. $1; cloth.

This excellent and useful compilation of engineering data peculiar to the city named is divided into two main parts, the first treating of local conditions, and the second of local materials. Under Part I. come geodetical and astronomical data, city datum, topography, climate, geology, cost of earth and rock excavation, pipelaying, deep foundations, earth borings, etc.; pressure on foundations and the Mississippi River at St. Louis. Part II. treats of the materials of construction in common use, stone and brick masonry, sewers, timber, fuels, etc. The committee to which was entrusted the preparation of this material was made up of Prof. J. B. Johnson, Mr. Robert Moore and Mr. S. Bent Russell, and these names are a sufficient warrant as to the nature and value of the data presented. From this book the stranger can form an excellent idea of the local conditions controlling engineering work in St. Louis, and the publication of these data establishes a precedent that should be followed in all the chief cities of the United States.

THE MICHIGAN ENGINEERS' ANNUAL, 1893. Containing the Proceedings of the Michigan Engineering Society for 1893. Published by the Society, Kalamazoo, Mich. 8vo; 276 pp.

The contents of this annual include the opening address of President Muenscher and the papers read and discussed at the annual convention of the Society, held at Lansing, on Jan. 17, 18 and 19. An autobiographical sketch of Mr. John H. Forster, with a portrait, opens up the volume. The papers read are given by title as follows, and several of them will be published in full or in abstract in this journal as space permits: "Southern California and One of Its Water Systems," by A. L. Reed; "Specifications," by G. L. Wells; "Method in Village and Cemetery Surveying," by F. L. Church; "Methods Employed in Laying Out a Town Plat," by A. J. Teed; "Township Burying Grounds, Plats and Records," by D. J. Albertson; "Report of Special Committee on State Boundary; Good Roads," by E. W. Muenscher; "Improvement of Common Highways," by R. C. Carpenter; "The New Road Law," by Seth Dean; "Wagon Roads," by J. H. Forster; "Highway Laws of New York," by O. C. Gillette; "Florida Road Laws," by S. C. Hodgman; "Roads and Road-Making in Oklahoma," by John G. Watkins; "General Road Statutes of New Hampshire," by Ray T. Gile; "Railway and Highway," by H. E. Riggs; "The Relation between Public Highways and Railways," by E. French; "Legislation for Better Roads," by Geo. E. Steele; "Discussion on Road Laws; How to Make a Good Road from the Material on Hand," by M. H. Bailey; "Stone Roads in Bay County," by H. C. Thompson; "Country Roads and Road-Making," by F. Hodgman; "Purchase of Metal Bridges," by B. F. La Rue; "Village Surveys and Their Records," by F. H. Williams; "Swing of the Compass Card," H. C. Pearsons; "A Case of Draining through Quicksand," by F. F. Rogers; "Public Water Supply and Public Health," by W. R. Coats; "Water-Works at South Haven, Mich.," by George S. Pierson; "Street Gradients," by A. L. Marhoff; "A Digest of Legal Proceedings." As will be seen the subject of highway construction furnishes a topic for the bulk of the papers presented and much useful material is contained in them.

TWENTY YEARS' PRACTICAL EXPERIENCE OF NATURAL ASPHALT AND MINERAL BITUMEN. By W. H. Delano, Assoc. Inst. C. E., General Manager of the Compagnie des Asphaltes de France. London and New York, E. & F. N. Spon. 12mo; 73 pp.

The author of this work practically confines himself to the natural rock asphalts, but commences with a chapter upon the nomenclature of asphalt and its combinations and includes mineral bitumen of Trinidad and elsewhere in this list. The probable origin of the bituminous limestone deposits is described and the author defines asphalt as being the natural combination of 7 to 20% of bitumen with carbonate of lime, and classes as a misuse of terms the expression "asphalt from the Trinidad pitch lake." He says that bitumen and mineral pitch are interchangeable terms; but that asphalt stands alone. Part II. is devoted to the uses of asphalt, specifying its adaptability to moisture-excluding construction, to floors, for coating masonry arches, for stopping vibrations from fast moving machinery, etc. The durability of asphalt pavements in Paris is noted and the advantages of this class of pavement are set out at length as compared with other types of pavement. Part III. deals very fully with the methods of setting out compressed asphalt roadways, illustrating the tools used in contouring roads and in laying pavements and in other works involving the use of asphalt is some of its forms. The work concludes with some brief but useful notes on the traffic on Paris and London streets and the cost of work in Paris. While written from the standpoint of one thoroughly imbued with the superiority of natural rock asphalt over all other types the book contains many useful hints to the user of asphalt. This work was sent us by the New York Mastic Co., and doubtless other copies can be obtained from the same source.

SOCIETY PROCEEDINGS.

INTERNATIONAL ENGINEERING CONGRESS.—(Concluded from page 113).—We gave last week a report of the proceedings of the divisions of civil, mechanical, mining and metallurgical engineering, and continue this week with the proceedings of the marine and naval, and military engineering, engineering education and the congress of aerial navigation:

Division E, Engineering Education.

The first paper presented on Tuesday, Aug. 1, was on "Maximum and Minimum Mathematics Necessary for an Engineer," by Prof. A. N. Talbot. The author thought that the study of mathematics has large value as preparatory to the presentation of technical studies, but that engineers fail to appreciate the usefulness of the study. The student should be so drilled that he may use mathematics as a tool. A table showed the relation between time given to pure mathematics and that devoted to the entire course in 12 engineering schools. Following this were papers on "Present Favorable and Unfavorable Tendencies in Engineering Education," by Prof. Palmer C. Ricketts; "Comparison Between American and European Methods of Engineering Education," by Prof. George F. Swain; and "The Ideal Engineering Education," by Prof. W. H. Burr. Professor Burr considered mathematical training of the utmost importance, from the relation of abstract science to practical engineering. Whipple was practically the first man to grasp the mathematical principles of strains, and he applied them in bridges which were correctly designed from a theoretical point of view. A practical study of engineering works is very important, as in field and shop work, preparation for specifications and estimates, etc., but no education can make a practitioner; it can only fit the student for practical work. Students should also be made to understand that there are economical as well as mechanical principles to be considered, as in cost of material, labor, transportation, erection, etc., and no school of engineering can be considered as satisfactorily performing its ends if it does not do this.

After some discussion of papers presented at this and the former meeting, Professor Robinson gave some particulars of the Engineering Teachers' Association, which is now being organized on a practical basis. It was first organized about two years ago by teachers of mechanical engineering, but now includes those of all branches and has some 65 members. Professor Robinson, of Columbus, O., is President.

In the evening there was a pleasant and largely attended reception for members of the divisions at the engineering headquarters.

This division had a large and representative attendance on Wednesday, Aug. 2, and the following papers were presented: "Shop and Laboratory Equipment," by R. H. Thurston; "Laboratory of Hydraulics at the Massachusetts Institute of Technology," by Dwight Porter (this laboratory was described in our issue of June 22, 1893); "Graphical Solution of Problems," by Prof. H. S. Hele-Shaw, England; "Practical Laboratory Work," by Prof. R. G. Carpenter; "Original Research by Students," by Prof. C. D. Marx. There was some considerable discussion on Professor Hele-Shaw's interesting paper, and all the speakers referred to the importance of graphics as a companion to, but by no means as a substitute for, mathematical computations. Dr. Ritter, of Zurich, referred to the system of instruction in graphics in Switzerland, and one speaker said that as a rule engineers were not good computers, owing largely to the fact that arithmetic is not properly ground into scholars in their early education.

In the afternoon a party proceeded by the steamer "T. C. Burrows" up the odoriferous Chicago River from State street to the new folding bridge, built by Schailer & Schniglau (at whose invitation the trip was made), at Canal street. This novel and interesting type of opening bridge, was described and illustrated in our issue of May 23, 1891. The steamer then proceeded down the river and out into the lake, making a trip to the four-mile crib of the water supply tunnel.

The first paper on the list for Thursday was one on "Field Equipment and Field Practice," by C. D. Jameson. Professor Monroe said that Columbia College leased a farm which had been covered with stone monuments to be used in leveling, etc., so that the student's work could be checked at every step, but Professor Merriman pointed out that this did not represent actual practice and was based on the presumption that students would cheat in their work and figures; he thought Professor Monroe alluded to a very strange practice and one by no means deserving of commendation. The other papers were as follows: "Methods of Training Engineering Students in Technical Literary Work," by Prof. Mansfield Merriman; "Methods of Studying Current Technical Literature," by Prof. J. B. Johnson, in the discussion of which it was stated that while students will read current technical literature it is difficult to set them to study historical technical literature; "Drawing for Engineering Students," C. D. Denison. There was a large attendance in this division at all the meetings, and there was discussion on nearly all the papers.

At the Friday's meeting two papers were presented: "Vacation Work," by Prof. A. E. Burton, and "Graduation Theses," G. Lanza. Both of these were followed by interesting discussions. This division was very successful, its meetings were largely attended, and the papers were freely discussed. The list of papers was not too long to prevent them from being read in full and still leave ample time for discussion. A permanent organization was effected, particulars of which are given elsewhere.

Division F, Military Engineering.

The papers read before this division of the Congress were probably of less interest to most of our readers than those of any other division, and the number in attendance at its sessions was considerably smaller. Three papers on "Coast Defense," two by English officers and one by Col. H. L. Abbot, U. S. A., were the first presented. Colonel Abbot's paper gave an interesting summary of what the United States has done and plans to do to protect its seaports from bombardment, and all the papers were quite reassuring to timid dwellers in the Atlantic coast cities. In somewhat the same line was a paper by Col. W. R. King reviewing the progress made in controllable torpedoes operated from shore stations. Some 16 different inventions in this line were described, including such well known ones as the Sims-Edison, the Guy, the Patrick and the Halpin-Savage. Prof. Jas. Mercur, of West Point, discussed "Military Land Mines," and a valuable paper on "Range and Position Finding for Purposes of Gunnery" was read by W. O. Smith, of the firm of Elliott Bros., of London.

Tuesday's papers were devoted still more exclusively to questions of purely military interest. "Intrenched Camps" were discussed by Capt. F. N. Maude, of the Royal Engineers, and Lieut. A. M. D'Armit, of the U. S. Engineers. "The Transportation of Troops and Supplies" was considered by Gen. S. B. Holabird, U. S. A., and Colonel Olbrecht, of Switzerland. The last paper, however, was of more direct interest to engineers. It was on "Military Railways, Bridges and Rolling Stock," by Capt. C. G. Bate, Royal Engineers.

A series of papers taken up at Wednesday morning's session were devoted to various phases of modern gun construction. Jas. A. Longridge, the English inventor of wire-wound guns, gave a history of wire-wound gun development, and argued in favor of his system as compared with others, or as compared with the gun built up of steel forgings. Capt. Rogers Birnie, U. S. A., discussed the question in a broader aspect; and Fleet Engineer George Quick, of the British Navy, presented a paper advocating, among other things, the "outside screwed union" system of gun construction, which admits of the gun's being repaired easily when any of the chase sections are in use. A still more valuable paper to the engineer interested in the metallurgy of steel was a paper by Lieut. Sidney E. Stuart, U. S. A., on "The Manufacture of Steel for Modern Guns and Other Ordnance Purposes." The author gave an excellent summary of the progress which has been made in the United States in the manufacture of guns, armor-plate and projectiles.

At Thursday's session some interesting papers on the work of topographical and the signaling branches of the army were presented, the most important being an interesting description of the signal corps of the U. S. Army by Gen. A. W. Greely, chief signal officer. Three other papers, by Lieut. Jervey and Maj. W. R. Livermore, U. S. Engineers, and Von Usedom, Chief of the Royal Prussian Government Survey, described military surveying and map making. Col. Alfred A. Woodhull, of the Medical Department, U. S. A., discussed "The Sanitary Relations of Military Sites." Dr. Paul Kohlstock described the measures taken for the sanitary supervision of the Elbe basin during the cholera epidemic in Hamburg in 1892, and gave numerous proofs of the fact that the spread of cholera is due almost wholly to the use of drinking water containing cholera bacilli. The other papers set for the session were "Some Remarks on Aerial Warfare," by Maj. J. D. Fullerton, Royal Engineers, and "Collection and Transmission of Intelligence in the Field," by Col. F. C. Beresford, of the same service.

The feature of Friday's session was Capt. Stanhope E. Blunt's paper on "The Modern Infantry Rifle." Captain Blunt was a member of the board which last year adopted a magazine gun of the Krag-Jorgensen type for the U. S. Army. His paper was an admirable review of the whole subject of magazine gun construction, and left one firm in the conviction that the United States' new weapon is second to none in the world. A paper of similar scope by Lieut. E. St. J. Greble was on "Rapid-Fire Guns." Capt. Henry Metcalfe contributed a paper on "Projectiles"; and two papers on "Explosives" were presented, one by Lieut. Willoughby Walke and the other by Mr. W. R. Quinan, of Pinole, Cal. A mathematical discussion of the motion of the projectile in its passage through the bore of the gun was contributed by Capt. Jas. M. Ingalls.

Division G, Marine and Naval Engineering.

The attendance and discussions at the sessions of this division were so good that it augurs well for the success of the recently organized engineering society devoted to this class of work. The first session on Monday opened with a series of papers on naval architecture, the titles and authors being as follows: "The Best Ship of War," Sir Nathaniel Barnaby, K. C. B., late Director of Construction of the British Navy; "The New Vessels of the U. S. Navy," by Lewis Nixon, Superintending Naval Architect for Wm. Cramp & Sons; "Naval Architecture in the United States," by Benj. Martell, Chief Surveyor to Lloyd's Register; and "The Present Condition of the Science of Naval Architecture," by Dr. Francis Elgar, Consulting Naval Architect. These papers were followed by two of quite as much interest to engineers in other departments as to the marine engineer: "The Triple and Compound Engines of To-Day and Their Further Developments," by A. E. Seaton, Managing Director of Earle's Ship & Engine Building Co.; and "Lubrication," by Chas. M. Everest, Vice-President of the Vacuum Oil Co., of Rochester, N. Y. Mr. Wm. Cowles described the absurdities of the ship's logs at present in use and laid down the lines on which an accurate speed measuring device should be constructed. Mr. W. D. Weaver described a speed and revolution recorder for engine room use.

On Tuesday two mathematical discussions were presented by Casimiro de Bona, Inspector-General of Engineers, Spanish Navy; the first explained the method of graphic integration devised by Rossin, and the second explained the author's valve diagrams. A third mathematical paper by Robert Mausel, of Glasgow, was devoted to the mechanical theory of steamship propulsion. An excellent summary of the benefits observed from the use of oil on waves at sea was presented by W. J. Millar, Secretary of the Scotch Institution of Engineers and Shipbuilders.

"The Vibration of Steamers" was discussed by Otto Schlick, of Hamburg. He approved of Mr. Yarrow's plan of balancing the rotating and reciprocating weights in the engines, but thought it was not practicable on the engines of very large steamers. Mr. Warren E. Hill, Vice-President of the Continental Iron Works, described the results obtained at that establishment with welded seams in plates. The interesting exhibit of the works in the Transportation Building at the Columbian Exposition deserves a reference in this connection. The remaining papers of the session were a long discussion of the steam jacket question by Chief Engineer B. F. Isherwood, and two papers on screw propellers, one by S. W. Barnaby and the second by Prof. W. Riehn, of Hamburg.

The greater part of Wednesday morning's session was given up to a discussion on boiler construction, precipitated by two important papers. One of these was by Nelson Foley, Manager of the Hawthorn-Guppy Engineering Works, of Naples, and was a review of the rules governing boiler construction imposed by the British Board of Trade, the British and German Lloyd's, the Bureau Veritas and the U. S. Statutes. The author took up each requirement separately and discussed in a critical manner the rules laid down by each authority. Mr. E. P. Stratton, Chief Surveyor of the "Record of American and Foreign Shipping," then read a paper on "Government Inspection of Merchant Vessels and the Influence Thereon of Registration Societies." He roundly condemned the present system of Government inspection in force in the United States as absurd, inefficient and dangerous in its results and gave numerous instances in support of his position, which were added to by Mr. Geo. W. Dickie, of the Union Iron Works and others. After the discussion was closed Mr. Dickie presented a paper on "Auxiliary Machinery on War Vessels." He advanced the novel and very attractive idea that the troublesome auxiliary steam engines in use on shipboard for driving the dynamos, blowers, ventilating fans, anchor windlasses, boat cranes, capstans and the turret revolving machinery might all be replaced with Pelton water wheels, operated by jets of water at 600 lbs. pressure per sq. in. This pressure water to be furnished by two sets of hydraulic pumps capable of delivering 386 cu. ft. per minute. Mr. A. A. Willson, Superintending Engineer of the Quintard Iron Works, described the hydraulic machinery operating the turrets and guns of one of the new U. S. armored cruisers now building at the works.

On Wednesday evening several papers illustrated by the stereopticon were presented. Prof. Wm. F. Durand discussed the design and equipment of modern plants for the construction of ships and marine engines. A paper entitled "Steam Boiler Feeding," referring especially to the best practice in feed-water heating with high-pressures and triple-expansion condensing engines was read by Jas. Weir, of Glasgow. Mr. Archibald Rogers outlined the development of the ice yacht on the Hudson, and gave interesting records of the speed attained, the highest for a 20-mile course being at an average rate for the distance actually sailed of a mile in 1 minute and 34 seconds.

On Thursday morning several papers, which were set for Wednesday but were omitted for lack of time, were briefly presented. They were: "Notes on the Machinery of War Vessels," by J. T. Milton, Chief Engineer Surveyor of Lloyd's Register; "Problems Confronting the Designer of Naval Machinery and the Success which Has Been Attained in Their Solution," by Ira N. Hollis, Assistant to Chief Engineer Melville, head of the Bureau of Steam Engineering; "Practical Stability Information," by Arthur R. Liddell; and "Diagram of Stability for Any Draft and Storage," by Pedro P. Leaone, Commandant of Engineers in the Dept. of Ferrol, Spanish Navy. The last two papers discussed methods of giving the shipmaster practical information as to the stability of his ship, enabling him to know on what angle of heel he may safely sail under various circumstances. Besides these the subjects "Liquid Fuel," "Forced Draft" and "Tubulous Boilers" were presented and discussed at length. The paper on the first topic was by Nabor Soliani, of the Italian Navy. The forced draft papers were by Jas. Howden, the designer of the forced draft system in use on several of the American and White Star steamers, and Henry Benbow, Chief Inspector of Machinery British Navy. Mr. Chas. Ward described the tubulous boilers designed by him for the "Monterey" and for "Torpedo Boat No. 2;" and the Roberts coil boiler, of which over 500 are in use, was described by its inventor.

On Friday morning the discussion on tubulous boilers was continued for some time. A valuable paper by Archibald Denny, of the noted firm of English shipbuilders, on "Speed Trials," was next in order. He pinned his faith to the measured mile trials as the test of speed; long runs tested, not the speed of the vessel, but the endurance of engines and boilers. Mr. Jas. E. Howard, Engineer of Tests at Watertown Arsenal, read a general paper on tests of iron and steel. He held that percentage of elongation should be based on the elongation which has taken place when the metal shows its ultimate strength. The drawing out of the metal close to the point of fracture should not be included. One of the most valuable papers prepared for this section had for its topic "Steel Castings as Used in Marine Machinery," and was written by Edwin S. Cramp, Superintendent of Wm. Cramp & Sons; he gave steel founders full credit for the enormous improvements in the quality of their product, which has been made in the past half-dozen years, but held that they were still behind the German, French and English founders.

The titles and authors of the remaining papers were: "Cocks on Water Gage Pipes," by Nelson Foley; "The Necessity of a Standard Indicator," by Chief Engineer David Smith, U. S. N.; "Marine Engine Valve Motions," by Chief Engineer Nathan P. Towne, U. S. N.; "The Coasting Sailing Ships of the Adriatic Sea," by Rodolfo Poli, Chioggia, Italy; "The Construction of Steamboats Navigating the Western Waters of the United States," by John M. Sweeney, of Wheeling, W. Va., and "Comparison of the Types of Steamers on the Great Lakes with Regard to Strength, Efficiency and Location of Machinery," by Joseph R. Oldham, C. E., of Cleveland, O.

The Aerial Navigation Conference.

We gave in our issue of July 20 an account of what it was proposed to undertake in this congress, or, as it was more modestly called, "conference." The program showed a list of 42 papers, many of them very voluminous, and the brisk discussion which took place during all the sessions (the papers being presented briefly in abstract or by title) will add considerably to the volume of the proceedings when put in type. At the opening session on Tuesday afternoon Mr. Octave Chanute, the chairman, reviewed briefly the history and present status of aerial navigation both in the department of navigable balloons and in aviation, or flying by means of aeroplanes. He laid down the law, which ought to be impressed at the outset on every student of the probelm, that while navigable balloons are, for war purposes, of some importance, their limited speed and small carrying power must forever prevent their commercial success. If man would fly he must try to imitate the birds, and not attempt to carry a floating gas bag about with him.

The first paper of the session, and one which struck the same keynote as many which followed, was by Prof. S. P. Langley, of the Smithsonian Institute, on "The Internal Work of Moving Air." Professor Langley has found by experiment and observation that moving air is very variable in its motion, first moving at high velocity, then apparently almost ceasing its motion. He believed that these alternate streaks of still and moving air were utilized by the birds for flight.

Mr. H. C. Vogt, of Copenhagen, Denmark, described the air propeller for propulsion of boats on water. He had been able to get as high an efficiency from an air propeller as from an ordinary screw. The air propeller was six times the diameter of the screw and one-half the pitch. It thus appeared that the air propeller was not so inefficient as has been supposed by any means. Mr. J. H. Dow, of Cleveland, described his steam turbine, with which our readers are familiar, and made the very interesting and novel suggestion that for aerial use the steam turbine should be used with an explosive gas mixture, such as is used for gas engines, thus saving the weight of the boiler entirely, as well as the weight of water. Prof. Thurston described the materials suitable for air-ship construction, and showed that steel ranks as the strongest material for its weight in existence. Prof. H. A. Hazen, of the Weather Bureau, gave an interesting account of the use of balloons for meteorological purposes.

On Wednesday the flight of birds and flying machines constructed in accordance therewith was the general topic of the papers considered. That birds sail and soar by taking advantage of wind currents appeared to be the general belief, and numerous papers were presented bearing on the subject. The last part of the session was the most interesting, however, when some of the papers came down to the practical discussion of how to fly. Mr. C. E. Duryea, of Peoria, Ill., and L. P. Monillard, of Cairo, Egypt, were both of the opinion that the way to fly was—to fly. The former believed that the main difficulty was the lack of a "flying school," where would-be aviators could become expert in the art with as little danger to life and limb as the bicycle learner finds in a well conducted cycle school. Both he and Mr. Mouillard were in favor of locating the "school" above a body of water, so that a fall would only mean a ducking, and the latter capped the climax by suggesting that a physician be made one of the staff at the flying school, which he had hoped to see established. The most interesting paper of the session was by Lawrence Hargreaves, of Sydney, New South Wales, who has made 18 flying machines of small sizes, all of which have been able to fly; and the latest and largest have flown over 500 ft. He himself has been able to fly downhill a short distance. He has constructed a steam engine weighing only 10.7 lbs. per HP., and is still continuing his experiments.

On Thursday ballooning was taken up; but as this branch of the subject would probably have little interest for our readers, we do not take space for a report of the session, which was the concluding one of the conference.

The papers presented were throughout of such a high order of merit that it is greatly to be hoped that the most important ones at least may be published. Such publication will at least do no small good in hindering cranks and frauds in their attempts to impose on the public and raise money for what may perhaps be appropriately called wild goose enterprises. At the same time it would do much to aid genuine students of the problem by showing them what had already been accomplished and would deter those unfitted to engage in the work by showing them the difficulties in the way.

The closing session of the congress, attended by all the divisions, was held on Saturday, Aug. 5, in Washington Hall, of the Art Institute, soon after 10 a. m., Mr. O. Chanute, president of the Executive Committee of the Associated Engineering Societies, in the chair. Brief statements of the progress made by the several divisions were then made:

Division A, Civil Engineering.—Mr. Metcalf, president of the Am. Soc. C. E., said that 63 papers had been presented, dealing with all branches of the profession. These were contributed by engineers of 12 countries, 18 being from the United States; about 318 engineers registered, and the average attendance was 125 at each session.

Division B, Mechanical Engineering.—Mr. Coxe, President of the Am. Soc. Mech. Engrs., said that in his division he had been impressed by the tendency to exact facts rather than mere suggestions and ideas. One of the most important matters reported was the committee's report on standard systems of testing.

Divisions C and D, Mining and Metallurgical Engineering.—Dr. R. W. Raymond, Secretary of the Am. Inst. Min. Engrs., said that while the papers presented had not shown any great discovery, they had shown great progress in many directions in regard to modern methods and machinery, and particularly to the extremely important and recent matter of application of the electricity to mining purposes.

Division E, Engineering Education.—Mr. Grant Allen referred to the fact that this had been the first convention on this subject, and briefly reviewed the general character of the papers presented. He also noted the establishment of a permanent organization as the outcome of the meeting.

Division F, Military Engineering.—Maj. Clifton Conly, U. S. A., reported upon the papers presented.

Division G, Naval and Marine Engineering.—Commodore Melville, U. S. N., considered the collection of papers presented to be the most important ever issued on this subject, and referred to the advantages of direct intercourse and discussion of such subjects by men from various countries. The average attendance was 70 at each session.

After these statements of the work of the committees, brief addresses were made by a number of foreign engineers, acknowledging the superiority of American engineering in many ways, particularly in its simplicity and practicability, its freedom in dealing with various circumstances and obstacles, and the great intellectual work evinced in the design and rapid construction of the great Exposition buildings. They also expressed appreciation of the attention, hospitality and courtesy of American engineers in general and of the Executive Committee in particular. Several also alluded to the importance of a standard uniform system of tests, and on the motion of M. de Rochemont a resolution was carried expressnig the sense of the meeting that a uniform international system of testing is desirable for the comparison of results in tests of materials. Among the speakers were the following:

Prof. Unwin, Great Britain; Baron Q. de Rochemont, France; M. Flamant, France; Mr. Hartmann and Mr. Reuleaux, Germany; Chev. Capacci, Italy; Prof. Nicolas Vosnessensky, N. Rycerski and E. de Zelenkoff, Russia; Alfred Van der Stegen, Belgium; Jan Bergendahl, Sweden, and Dr. W. Ritter, Switzerland. The congress then finally adjourned.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—This Society was organized by the engineering educators in convention at the International Engineering Congress at Chicago, reported in another column, and is a development of a former association of more limited scope. All those present at the meetings of the Division of Engineering were admitted as members, and practicing engineers as well as teachers of engineering will be eligible for membership. The Society starts out with about 60 to 70 members. The council will make an effort to secure the publication of the valuable papers and discussions on education presented at the meeting, no provision for the publication of which had been made by the World's Congress Auxiliary. The next meeting will be held in August, 1894, at the same time and place as that of the American Association for the Advancement of Science. The officers of this new society are as follows:

President, De Volson Wood, Stevens Institute.

Vice-Presidents, Geo. F. Swain, Massachusetts Institute of Technology; G. B. Christy, University of California.

Secretary, J. B. Johnson, Washington University.

Treasurer, Storm Bull, University of Wisconsin.

Council, Geo. F. Swain, Mass. Inst. of Technology; W. C. Raymond, Rensselaer Poly. Inst.; R. H. Thurston, Cornell University; W. H. Burr, Columbia College; De Volson Wood, Stevens Institute; Mansfield Merriman, Lehigh University; H. W. Spangler, University of Pennsylvania; S. W. Robinson, Ohio State Univ.; H. D. Eddy, Rose Polytechnic; W. F. M. Goss, Purdue Univ.; I. O. Baker, Illinois State Univ.; W. E. Cooley, Univ. of Michigan; Storm Bull, Univ. of Wisconsin; W. C. Hoag, Univ. of Minnesota; J. B. Johnson, Washington Univ.; F. O. Mardin, Univ. of Kansas; O. H. Landreth, Vanderbilt Univ.; G. B. Christy, Univ. of California; C. D. Marx, Leland Stanford University; H. T. Bovey, McGill College, Montreal; J. Gailbraith, Queens College, Toronto.

WATER COMMERCE CONGRESS.—A congress to consider the varied subjects coming under the head of water transportation held daily sessions at Chicago Aug. 1 to Aug. 5, and might very properly have been made a division of the Engineering Congress, as the subjects discussed before it were almost wholly those in which engineers are especially interested, and most of the contributors of papers and participants in the discussions were well known engineers. Hon. John C. Dore, of Chicago, was the presiding officer of the congress, and Prof. Wm. Watson, of Boston, was its secretary. Sessions were held daily, beginning on Tuesday morning, Aug. 1, and terminating Saturday morning, Aug. 5. The papers presented were of great interest, and the discussions were participated in by many prominent engineers, and were well maintained. Among the subjects of importance brought before the congress were the Nicaragua Canal, by Chief Engineer Menocal; the Lake Erie and Ohio River Ship Canal, by Thos. P. Roberts; improved water routes from the great lakes to the Atlantic, by Thos. C. Keefer, of Ottawa, Edward A. North, of New York, Samuel A. Thompson, of Duluth, and Chauncey N. Dutton, of Chicago; the commerce of the Mississippi River, by Geo. H. Morgan, Secretary of the St. Louis Merchants' Exchange, and the Chignecto ship railway, by H. G. S. Ketchum. We do not take space for a complete list of the papers, as the above will give a sufficient idea of the scope of the congress's proceedings. It is hoped that arrangements will yet be perfected for the publication of all the papers and the discussions upon them; but a delay of several months at least will of necessity ensue. Those of our readers wishing to secure such reports, if published, are invited to send their names and addresses to Prof. Wm. Watson, 107 Marlborough St., Boston, Mass., and in case it is decided to publish the proceedings, they will be informed of their price and can order them or not at their option. We shall publish in the Engineering News such parts of the papers as are of most interest to our readers at an early date.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Sept. 1. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Sept. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
Sept. 2. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 6. Secy., F. Collingwood, 127 East 23d St., New York.
WESTERN SOCIETY OF ENGINEERS.
Sept. 6. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 6. Secy., Arthur Thacher, Odd Fellows' Building.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York City,
as Second Class Matter

VOL. XXX. THURSDAY, AUG. 17, 1893.

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EUROPEAN AGENCIES.
KEGAN PAUL, TRENCH, TRUEBNER & CO. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & CO. (Limited), St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES : One year, $5.00 ; 6 months, $2.50 ; 4 months, $2.00 ; single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.

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The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering Headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

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The engineer is accustomed to a lack of appreciation of and credit for his work by the public, but we think it is not often that he is so ignored by a fellow engineer as in a case which occurred at the International Engineering Congress in Chicago. Mr. F. W. Skinner, in an illustrated lecture on "American Methods of Erection for Bridges and Structures," before the division of civil engineering, illustrated some of the great steel structural work of the buildings of the World's Columbian Exposition. In each case he gave the name of the architect as the "designer," whereas the architects had nothing whatever to do with the structural design, but merely with the architectural design. As stated in our descriptions of these buildings, the structural designs were prepared by the engineers of the Exposition, and to Mr. E. C. Shankland, M. Am. Soc. C. E., is due the credit for the magnificent arch trusses of 368 ft. span in the Liberal Arts Building (Eng. News, May 12, 1892), as well as for much more of the novel and bold design of these interesting buildings, the construction of which was recognized by many visiting foreign and American engineers as one of the greatest wonders of the Exposition. It is with no sense of disparagement to the architects that we say this. Their work is admirable and beautiful, and they would be the last to desire credit which should properly be accorded to others. Mr. Skinner should have known, and might easily have learned, the facts of the case, and it is only just to Mr. Shankland and the engineers to correct this careless piece of injustice on the part of a fellow-engineer. An opposite case which might also be mentioned here was that Mr. Don J. Whittemore, in discussing the paper by Mr. Geo. H. Benzenberg on the flushing of the Milwaukee River, pointed out that the author had been too modest to present fully the conditions he had met with and the success which had attended his work. It is not often, he said, that the work of an engineer is recognized and appreciated by the public within 24 hours of the completion of such work. This was the case, however, at Milwaukee, when Mr. Benzenberg changed the Milwaukee River from an indescribably foul and nauseating body of water to a clean and pure condition.

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The series of tests to determine the effect of punching and shearing structural steel given on another page of this issue, serve to strengthen the evidence already existing, that up to thicknesses of, say, ½ in., these processes do no greater injury to steel than to wrought iron. This is especially gratifying since the general belief has been until quite recently, and, indeed, is common even yet, that soft steel required to be reamed after punching, or preferably drilled, to develop the full value of its greater strength and ductility for structural purposes. The chief drawback to the more common use of the metal by engineers has been due to this probably more than to any other one thing. The advantage of being able to use the punch for ordinary qualities of structural steel hardly needs to be pointed out. The simplicity, rapidity and economy of the process are all in its favor. Conservative estimates give the relative costs of punching, reaming and drilling as 1, 1½ and 3, and with a given shop area and capital invested in appliances probably at least 10% more material can be prepared by punching than by drilling. The results of the tests referred to would seem to show that the further tabooing of soft steel for this reason is inexcusable and can only be attributed to ultra conservatism and lack of progressiveness. Briefly stated, they show that steel not exceeding 80,000 lbs. tensile strength per sq. in., may be punched up to thicknesses of ½ in. without greater injury than wrought iron. Up to thicknesses of ⅜ in. no advantage seems to be gained by reaming the punched hole, indeed, the advantage seems to be on the side of the punched hole. Beyond this thickness, however, reaming is advantageous. In regard to drilling, the evidence presented is that no advantage is gained over reaming in thicknesses of less than ¾ in.

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The alleged scarcity of gold in the world and its decreased production and consequent increase in value seem to be the fundamental idea of the class now agitating for free silver. As an offset to this general statement, which is usually advanced without argument or proof, it will be instructive to review the facts of the case as set forth in the recent report of Hon. E. C. Leach, late Director of the United States Mint, on "The Production of Gold and Silver in the United States." This report contains a statement of the world's coinage for 1889-91, based upon official returns from the mints of all nations, and from this statement the following facts are gathered by the editor of the Columbia, S. C., "Journal": For the three years mentioned the world's coinage of gold averaged $145,800,000 per year, and while the reports of recoinage are not complete, that for 1891 puts the amount reminted at $23,760,000. Assuming an average, then, of $25,800,000 for the period specified, the original coinage for each year would be $120,000,000 in gold coin. In 1891 the world's stock of gold coin, as reported by Mr. Leach to the U. S. Senate on May 24, 1892, was $3,656,000,000, consequently the annual net coinage of gold for these three years has amounted to 3⅓% on the total stock. As Mr. Edward Atkinson places the civilized world's increase in population at only about 1% per annum, and as even the most sanguine estimates do not figure upon anything like an increase of 3⅓% annually in the total business of the world, there still seems to be a very sufficient supply of new gold added each year to our general current funds, an amount quite sufficient to afford a safe basis for commercial transactions as now conducted.

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As to the United States itself, the report of one year ago showed that the total money in circulation, exclusive of what was in the United States Treasury, was $1,529,000,000. In 1892 the United States' mints coined $34,787,000 in gold, or about 2¼% of the total circulation. And besides this coin the mints last year manufactured $23,290,000 in gold bars which practically added still further to the gold coinage, for a considerable number of these bars were exported in adjusting trade balances and thus did the work of gold coin. As to the alleged decrease in the supply of gold in the world the same report presents these facts: For the 15 years 1873-87, the world's average yearly production was $103,925,000; while for the five years 1887-93 the annual average is $119,633,000, and the product for 1892 rose to $130,816,000, a figure exceeded by only five years in the early "fifties," when the discovery of gold in California and Australia was adding abnormally to the world's production; and yet for the 10 years 1851-60 the average production per year was only $131,982,000. The fact is that since California and Australia, and lately South Africa, began production the world's annual output of gold has enormously increased as compared with the centuries preceding 1850. According to the best available estimates the world's total production of gold from the discovery of America, in 1492, to 1850 was 152,800,000 oz.; but from 1851 to 1892, inclusive, the output has been 232,000,000 oz., or an average of $114,176,000 annually since 1851 as compared with an average of $8,815,000 for the 358 years preceding 1851. These figures should furnish food for a little sober reflection on the part of those now seeking to radically change and "reform" existing metallic conditions.

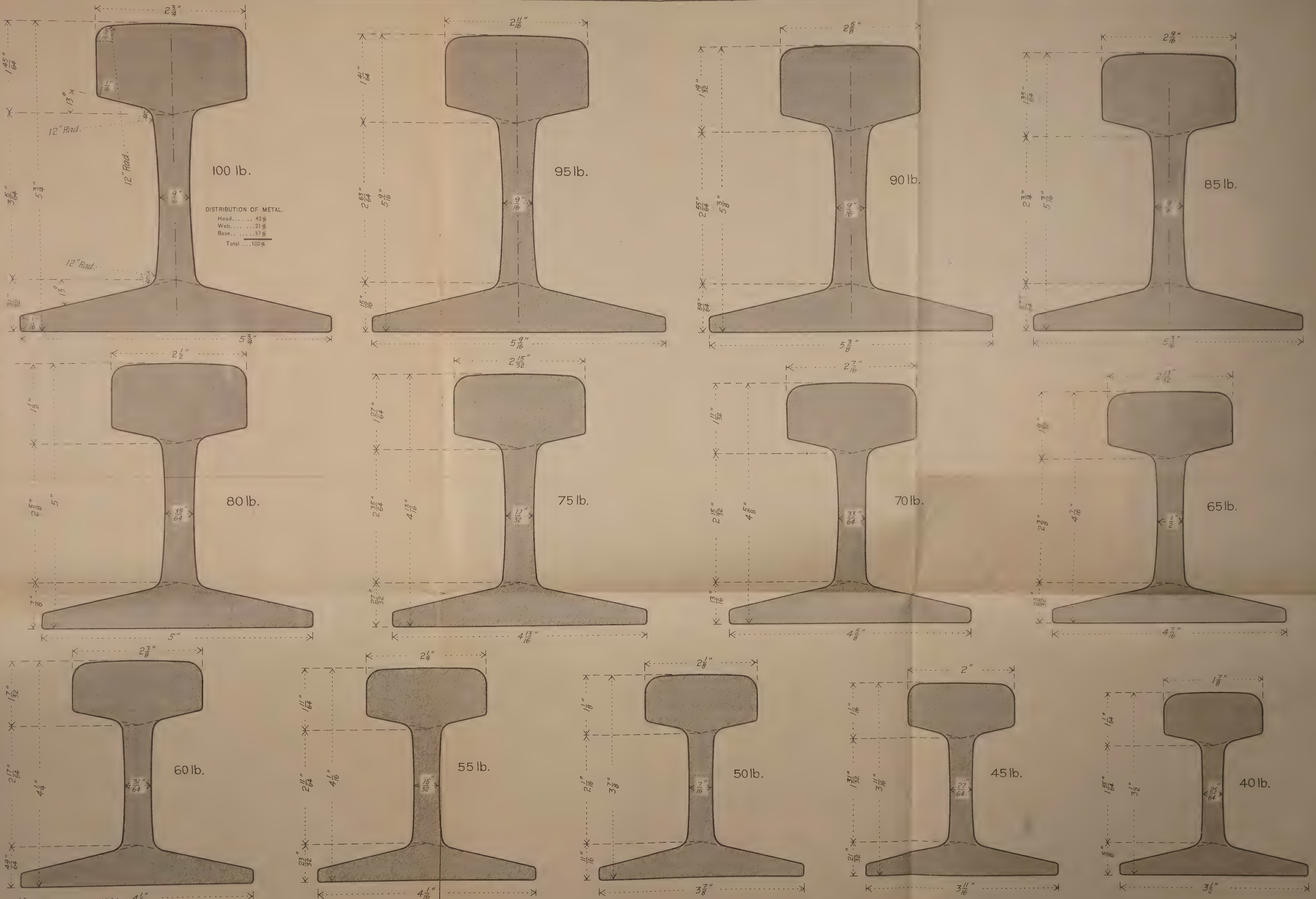
THE AM. SOC. C. E. STANDARD RAIL SECTIONS.

Although the American Society of Civil Engineers, as a body, does not, in fact, adopt or recommend any standards, and certainly has not and will not, as a body, adopt or recommend the sheet of sections given in this issue, or any other standard sections for rails, yet the inconvenience and verbosity of accurately defining them, as "the sections recommended for general use in the report of the Committee on Standard Rail Sections, appointed by the American Society of Civil Engineers, to report on that subject," is such as to require the short cut to an approximate truth which heads this article.

The movement, of which this series of sections is the culmination, toward a more accurate determination of the best forms of rail sections, began more than 10 years ago, and was not begun by engineers, but by car-builders. It was observed long ago that a certain proportion of car wheels developed a tendency to cut in the flange. It is an objectionable tendency, albeit it appears much more than it is, since it was even then well known, and is now a well proved fact that such wheels are almost or quite the longest lived of all, making more mileage before they need to be removed for this cause than any other class of wheels which are removed for other causes. Moreover, only from 1 to 8% of the wheels removed fail from this cause at all.

There was, therefore, no money loss from this defect, but there was a certain element of danger in a sharp-flanged wheel, and the Master Car Builders' Association, through a committee headed by Mr. M. N. Forney, set itself to discover and recommend a remedy. The discussion was continued

SUPPLEMENT TO ENGINEERING NEWS, AUGUST 17, 1893.



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Web....	...21%
Base..	.....37%
Total	...100%

RAIL SECTIONS RECOMMENDED AS STANDARD BY THE COMMITTEE ON STANDARD RAIL SECTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

(Dimensions which are Constant for All Sections are Shown only on the 100-lb. Section. On Other Sections the Dimensions Special to Each are Alone Shown.)

G. Bouscaren, Chairman; R. W. Hunt, Secretary; V. G. Bogue; Foster Crowell; S. M. Felton, Jr.; H. Stanley Goodwin (Deceased); J. D. Hawks; Geo. S. Morison; E. T. D. Myers; Samuel Rea; Thos. Rodd; A. M. Wellington and F. M. Wilder, Committee.

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for several years, and attracted much attention. This committee, led, perhaps, by a natural and very human weakness for throwing the blame for any defect onto some one else than themselves, concluded and reported that wheels wore to flange because the rails were sharp cornered and did not "fit the flange"; and they demanded that a standard radius of ⅝ in. or thereabouts should be adopted both for rail corners and for wheel flanges, so that they might accurately fit each other over the whole of a large rounding corner. They declared that "nothing in mechanics was more firmly established or more certain than that the wear of surfaces in frictional or rolling contact is in inverse proportion to their area."

No voice was raised on the other side, and the result was a decided and wide-spread tendency to conform to this demand of the car builders, which is visible in the rail sections of that day (1880 to 1885) which grew rapidly more and more round cornered, few companies having the courage to resist this demand altogether, although a few went only half way.

Nevertheless, there were some tremendous gaps both in their facts and in their logic, which at least prove that this demand was unwarranted by any facts adduced, and it is now all but unanimously admitted that it was wholly without any rational foundation. In the first place, as all wheels alike ran over the rail corners objected to, why did not all wheels alike wear to flange instead of a trifling percentage only, if the rail corners were the true cause? It is certain that the same cause, acting in the same way, at the same time, on the same bodies, should produce always the same effect. If it does not, there is strong proof that the cause had been misjudged.

In the second place, there are two defects of car trucks which are known to exist in a certain percentage of wheels which naturally tend to produce sharp flanges, viz., mismatching of wheels as to diameter and trucks out of square. These are so frequent as to alone suffice to explain the full percentage of sharp flanges, and also to explain why that percentage is no greater than it is. By ascribing the whole trouble to the rail corners, as the car builders did, there were no effects left to ascribe to these known causes—for which the car builders were responsible, while for the rail corners they were not.

In the third place, what was really a knockdown argument against there being any foundation whatever for the car builders' plea, there is not a single well authenticated case on record of two sharp flanged wheels on the same axle. Whenever one wheel is wearing to flange the other is invariably found to be wearing away from flange. The only apparent exceptions ever found to this law are when wheels are known or reasonably supposed to have been re-mated after sustaining more or less wear, some car builders following the practice of re-mating sharp-flanged wheels together, with the idea that they will run better thereafter.

This well established fact made it practically certain that, far from being the only or chief cause, as the car builders claimed, the rails could not have any sensible effect whatever even to aggravate flange wear. For whatever effect the rails have must obviously be given to both wheels alike, not at the same instant, indeed, but alternating, while mismatched diameters and trucks out of square act always on one wheel. Thus we have a means of differentiating absolutely the effect of the rails and of the other defects stated to cause sharp flanges. If it were invariably found that both wheels alike wore to flange, the whole blame would be thrown upon the rails (or some other common cause) and none to the constructive defects. If one wheel always showed half as much tendency to flange wear when its mate wore to flange, the blame would be divided half-and-half. If the other wheel sometimes showed some slight tendency to flange wear, some possible small effect might be ascribed to the rails; but when, as was the fact, one sharp-flanged wheel on an axle was always accompanied by a mate which showed a positive aversion from any tendency to flange wear, facts and logic could not more completely remove from the rails all rational cause for suspicion that their form contributed in any degree to cause or aggravate flange wear.

Our carbuilding friends did not perceive the force of these facts, however, and hence they were still less likely to perceive the defects of their reasoning as to laws of physics. It will be obvious, however, that there was a frightful gap in their logic on this point also. Inasmuch as the flanges may be said to be always bearing against the rail on one side or the other, both on tangents and curves (for there is nothing else but this bearing to guide the truck along the rails), to shape the rail heads and flanges so that they shall exactly fit each other all around the corner means that there shall be a grinding friction at all times on the one side or the other, because the pure rolling motion is confined to the top of the rail, and all points in the flange below that level are moving faster than the tread, because revolving in a larger circle with the same angular velocity, and hence must necessarily grind. Now, although it may be granted that with rolling contact only it is an advantage to increase the bearing surface for the same load, and though it may also be granted (though this is not nearly so certain) that with rubbing contact only the same holds true, yet it by no means follows that when we enlarge the rolling contact by introducing a rubbing contact which otherwise would not exist, we are gaining any advantage. On the contrary, there is a strong probability that vastly more harm than good will be done, since unlubricated rubbing contact is vastly more destructive than rolling contact, which latter may be concentrated on a very small area without doing any harm, as is illustrated in every ball-bearing, in which the load per square inch is almost infinite, while yet hardly any abrasion results in long periods of use.

No one had taken the trouble to point out these facts, however, and practice was tending distinctly toward very large corner radii of ½ to ⅝ in.—"to suit the demands of the Master Car Builders," as one rail maker put it, when, on March 27, 1885, a communication signed "C. E.," and bearing the title "The Master Car Builders on Rail Sections and Flange Wear," was published in the "Railrod Gazette," of this city, reciting these and many other facts and impugning the soundness of the car builders' theories and demand for a round corner. The general tenor of the article may be inferred from its closing sentence: "As it (this demand) comes before the railroad world, owing to the circumstances detailed, with all the force of a careful, deliberate and well considered demand by the carbuilding interest for the reform of an intolerable, or at least great, evil, it has seemed essential to point out in detail that the demand is neither careful nor deliberate, nor well considered, nor (probably) founded on any sound basis of fact or theory."

It is a historical fact, we believe, that this was the first and for some time the only voice raised against the round corner theory; not that many engineers did not doubt it and act contrary to it, but that no one took the trouble to defend his position, and that one by one they were falling into it. The Pennsylvania R. R. took a leading and an active part in favor of very round corners, and its example naturally had great influence. It is an open secret, however, that the impetus in this direction came chiefly from officers of the motive power department, and that the engineering department, having rail sections in charge, was indifferent or hostile to this view.

It was natural, therefore, that the letter referred to, taking up the cudgels unqualifiedly against the illusion of the hour (if it was such, as is now generally believed), should excite considerable interest and discussion, and it did do so. Adherents and confirmatory evidence flowed in rapidly, and a number of roads which had been contemplating round cornered rails abandoned that intention or suspended their judgment. No answer to the letter was ever attempted, and from that time to the present day there has been a steady and uninterrupted tendency away from that type, until now it is the rare exception, being adhered to by only one considerable road, the Lehigh Valley, on which the type originated. It soon became known among those interested that Mr. A. M. Wellington was the author of this letter signed "C. E.," and he now claims the credit of having individually stopped an unchecked current of practice toward an alleged erroneous theory by calling attention to its weakness, and thus caused that general investigation which has since resulted in the practically complete abandonment and reversal of that theory and practice.

At the convention of the American Society of Civil Engineers next following this letter (June, 1885), Mr. Wellington followed up this letter by offering a resolution, which was adopted, for the appointment of a committee on the "Proper Relation to Each Other of the Sections of Railway Wheels and Rails," of which Mr. H. Stanley Goodwin, of the Lehigh Valley R. R., was made Chairman. This committee submitted a unanimous preliminary report in 1888 and a unanimous final report in 1889, reporting emphatically in favor of a comparatively sharp corner radius (¼-in.), 12-in. top radius, 1-16-in. lower corner radius, vertical sides to head, and a wide head relatively to depth. These recommendations were each separately sustained by a heavy majority of 6 to 12 to 1 for each, among members consulted by letter, all given by name. In closing their report the committee said that such unanimity had developed in regard to the details of the head, the most disputed point, as to make it appear probable that a complete set of standard rail sections might be designed which would be accepted with an equal approach to unanimity.

The result of this recommendation was the appointment of a much larger committee, of 13 instead of 7, to devise and recommend such sections. The names of the committee and the result of their deliberations appear on another page. Their report was presented at the business session of the late Engineering Congress, at Chicago, and was short and mostly formal, not entering into any technical discussions. A majority of this committee had not been members of the former committee, so that its decisions are in effect a review of the case by a higher court. It will be seen that in respect to the head the sections are precisely in accordance with the former committee's recommendations, with one exception—the radius of the corner has been slightly modified and enlarged, from 1-4 to 5-16 in. This leaves the principle of design precisely the same, but makes a slight concession toward those favoring a larger radius, not enough to do any sensible harm, but enough, let us hope, to insure more general and speedy acceptance than might otherwise be possible.

The other details of the sections call for no special remark; they are in the direction of present tendencies. It will be observed that the widths of head do not vary by a uniform amount, but by ⅛ in. between 40 and 60 lbs., inclusive, 1-32 in. between 60 and 80 lbs., and 1-16 in. between 80 and 100 lbs. This appears unreasonable, and yet there is an obvious practical end to be gained. It is desirable that the widths of head should vary as little as possible on the most used sections, but on the lighter sections, unless the widths contract pretty rapidly, the heads become too thin, while on the very heavy sections, if the widths do not increase tolerably fast, the heads become too deep for what is now generally recognized as a great desideratum for good rolling, a relatively thin, wide head. Moreover, on the much used sections, like 60 to 80 lbs., it is obviously desirable to deviate from established and popular dimensions as little as possible.

The one question which seems sure to arise in the future in regard to the very heavy sections, which are likely to be used chiefly in combination with tie-plates, is whether or not it is wise to retain the base as wide as the height of the rail when plates are used in every tie. We question whether it is; but a committee reporting on such a subject is necessarily tied down chiefly to what is, and not to what may be.

It is already certain that the new sections will be very extensively used. Some of them have already passed into use in advance of formal recommendation. Whether they will become general or not is yet to be determined. Formidable individual preferences will doubtless be adhered to in many cases, for a time at least, and, perhaps, with justice. But that the trend of practice will be almost universally toward sections approximating to these in essentials, we believe to be certain.

CENTRAL RAIL TRACTION DEVICES FOR RAILWAYS.

The accompanying illustrations were accidentally omitted in publishing Mr. John C. Trautwine's letter in our last issue. The titles beneath them, with reference to our last issue, will fully explain them.

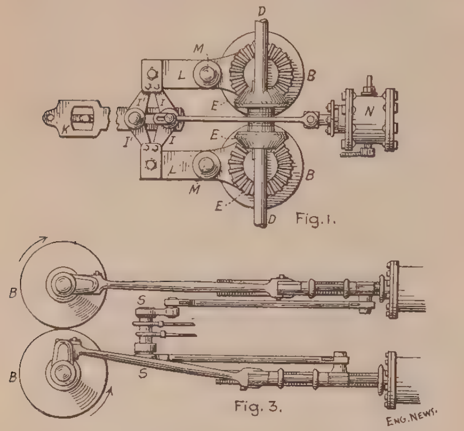


Fig. 1.

Fig. 3.

Central Rail Gripping Device for Steep Grade Railways, Invented by Geo. Escol Sellers, 1849.

LETTERS TO THE EDITOR.

IRON BRIDGES VERSUS TORNADOES.

Sir: In your issue of 3d inst., under heading "Ferris Wheel in a Storm," you editorially remark: "Strong against anything but a genuine tornado, which latter, of course, cannot be resisted by any such wheel any more than by an iron bridge."

This seems to assume that iron bridges cannot resist tornadoes. Now, we have had accounts of tornadoes over wide areas of our country, during recent years, when iron bridges have been extensively used for both railroad and highway purposes; and yet the instances of the destruction of such bridges, if recorded, have entirely escaped my notice. Can this be entirely accidental?

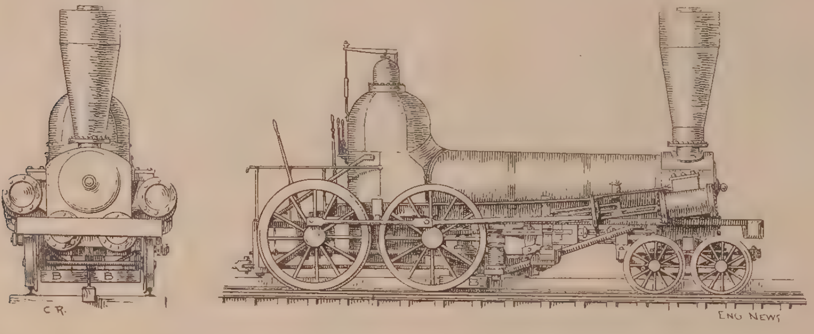


FIG. 2. LOCOMOTIVE EQUIPPED WITH SELLERS' CENTRAL RAIL GRIPPING DEVICE.

Will not some of your readers, who have observed the tracks of tornadoes, report the results of such tornadoes upon any iron bridges within the area of destruction, whether injured or uninjured? And, if possible, the general character of the bridge as to its theoretical power to resist wind forces. Yours truly, T. C.

New York, Aug. 4.

THE METRIC SYSTEM.

Sir: The favorable opinion of the metric system given in your recent editorial will have more weight with engineers than anything that has been written on the subject for a long time. For it is a well known fact that the Engineering News is not cranky on any subject, but, on the other hand, is decidedly conservative in all expressions of opinion. A discussion on the same subject has been going on in England through the columns of "Engineering" for several weeks past, but it has been mostly a one-sided discussion, the letters being nearly all from those favoring the system. The question of how to secure a more general adoption of the units of the metric system will come up in the World's Congress of Electricians in Chicago soon.

What practical advantages would American engineers gain by adopting the metric system?

1. Uniformity with French and German engineers. There would be, however, no very great practical advantages to the majority of American engineers in this.

2. Conformity to Mexican and South American legal measures, thereby probably increasing somewhat the demand for American engineering supplies of all sorts—materials, tools, machinery, etc.

3. The abolition of our incongruous, difficult, absurd tables of weights and measures which an engineer must at present either memorize or keep always at hand in some book.

4. The entire elimination of much complicated and tedious calculation and the simplification of the unavoidable remainder. This is the strong point of the metric system. It is of more practical every-day importance than the other three combined. An example will best illustrate this advantage. As a very mild example, where our present system chances to have an exceptional advantage in the well known simple ratio 11–7: How many tons of 60-lb. rails will be required for 45 miles of railroad? ($60 \times 11–7 \times 45 = 94.286 \times 45 = 424,287$.) How many tons (metric) of rails weighing 30 kilos (kilograms) per meter will be required for 70 kilometers of rail road? ($30 \times 2 \times 70 = 420$.) This is a very simple example. The more complex the examplo the greater the saving the metric system will show in comparison.

Included in this fourth advantage is the benefit which would result from having the numbers, values (or whatever they should be called) which an engineer must continually carry in his head easily and simply related to each other. For instance, if iron is worth 3 cts. per lb., what is it worth a ton? A grade of 40 ft. to the mile is what per cent.? A batter of ⅓-in. per ft. is what decimal of a foot for each foot? If a cubic foot of cast iron weighs 480 lbs., what does a cubic inch of it weigh? If a horizontal line deviates from the curve of the earth's surface 8 in. in a mile, how many hundreths of a foot does it deviate in 1,000 ft.? A probable error in chaining of .005 ft. per ft. is how many inches per mile? or, how many inches per chain (66 ft.)? or, how many links per chain? All of these questions would be vastly simpler in the metric measures.

What disadvantages or faults does the metric system, in itself, have? That is, leaving out of question the disadvantages which any change (even though it be from bad to good) unavoidably has.

1. These due to the disadvantages of the base (10) on which the system (in common with our arithmetic) is founded. Ten cannot be divided by 4 nor 8 (3, 7, etc., do not matter so much) without remainder. Ten has neither an exact square root nor cube root. Theoretically this last is a serious fault, but practically it is not very important.

2. The inconvenient size of the units. A chain 100 ft. long is perhaps more convenient for laying out railway curves than a chain of 10, 20, 25, 30, 50 or 100 meters. Millimeters seem to be too small, and centimeters too large, in some cases where eighths of an inch seem just to meet the requirements. Still sometimes the advantage might be on the other side.

On the whole, is not the metric system a good thing? If it is, every engineer ought to familiarize himself with it, as it is used in France and Germany in practice. For instance, he should know that over half of the names such as dekameter, hectogram, deciliter, etc., are seldom—some of them almost never—used even in France, there being no practical need for such denominations except in rare instances, and their omission making the system very much simpler. It will be the system of this country some day, and if our engineers would familiarize themselves with it that day would not be very far distant. Yours truly,

DECIMAL.

Nashville, Tenn., Aug. 2, 1893.

(Our correspondent's views are essentially correct, in our judgment. That we must and shall in time adopt the metric system is, in our judgment, certain, and if so, the sooner we do it the better we are off; but it is undoubtedly a herculean task to change the units of weight and measure in which a great nation thinks, and one which necessarily involves some transitional inconvenience and trouble. Still, from personal experience, we can testify that it is less difficult than one would think for a mature adult to learn to think and work with metric units, and as the only change necessary in patterns and standards is to stamp some new numbers on them, the transition would be easier and shorter than appears, and need not necessarily occupy more than a year or two in the large shops, where the greatest difficulties are to be expected. With the people whose only serious contact with weights and measures is in buying pounds of butter and yards of cloth the change would be slower, but also less important. Mexico has done it already, the common people understanding meters as well as "varas," or yards, which, in their case, are only 2½ ft. long.

As for the other objections to the metric system, on the score of practical suitability, they are all of them pure humbug, in our opinion. There is absolutely nothing in any one of them, and we speak from practical experience with both. It is unfortunate for the metric system that its true simplicity does not appear in the tables, any more than the true simplicity of our money system, 100 cts. equals $1, appears in the table of mills, cents, dimes, dollars and eagles. Those terms are occasionally put to some special use, but practically the public knows but two units. Similarly the true metric table of length is only: 1,000 millimeters = 1 meter; 1,000 meters = 1 kilometer; and that is the end of it. Similarly the true table of weights is: 1,000 milligrams = 1 gram, 1,000 grams = 1 kilogram, 1,000 kilograms = 1 ton; and so also for volumes.

As to shop practice, there is no kind of comparison. The inch is a very poor unit for such work, since it necessitates constant practice. The millimeter is the metric shop unit, and one has only to look at any metric shop drawing, as for instance, of a locomotive, to see its immense convenience. Being only the 1-25 part of an inch, it is practically the shortest unit recognized in shop work; and whether one wishes to express a distance of "5" (1-5 in.) or "14,787" (14.787 meters, or some 49 ft.), it comes in equally convenient and equally intelligible to the meanest capacity; whereas with the inch almost every dimension has to be in fractions, which are a source of constant error.

For land surveying practice the 20-meter chain divided into 100 links of 200 mm. each, is almost equally superior to the 100-ft. chain, which last has only its "decimality" to recommend it. The 66-ft. chain (practically identical with the 20-meter) is a much more convenient unit. This will be a hard saying to many American engineers who have become accustomed to the 100-ft. chain, but we speak from a large experience with both, in which originally prejudice was all the other way. Similarly the kilometer is intrinsically a much better unit than the mile for large distances.

As for weights, the tons are practically identical, and the kilo. a better unit than the pound for American practice, though in the lands of small purchases the half-kilo. is much used. The liter is also sufficiently near to the quart to make the transition a simple matter. The immense commercial advantage of being in line with the best of the world in this matter will, in the end, conquer conservatism, and when we have once changed England will have to change, and the world will have but one system of weights and measurements. —Ed.)

NEW VENTILATING AND COOLING PLANT FOR MACHINERY HALL.

The excessive heat in Machinery Hall, at the Columbian Exposition, has been the subject of much complaint, and a large number of exhibitors have united in a petition that means be taken to remedy it. The power plant on the south side of the building contains steam engines aggregating over 20,000 HP., and the amount of heat given off is, of course, enormous. Underneath the floor is over a mile of steam piping, and the only ventilation of this basement at present is through openings in the floor directly into the hall.

To cope with this state of affairs an extensive ventilating plant is now being put in place, comprising three separate and independent systems. For ventilating the main hall itself and the main part of the basement, which contains only the steam pipes supplying the engines which drive the line shafting, a centrifugal blower, with a capacity of 150,000 cu. ft. of air per minute, is being built by the Cyclone Fan Co., of Streeter, Ill. This will be set up in the annex, near the pumping engine tank, and will deliver through a short shaft extending just above the roof. It will be driven by a belt from a line shaft and is expected to require about 25 HP.

TABLE IV.—Showing Stock and Bonds per Mile of Railway for Each Year, 1882 to 1892, Inclusive.

	Group 1. Me., N. H., Vt., Mass., R. I. and Conn.		Group 2. N. Y., N. J., Pa., Del. and Md.		Group 3. O., Mich., Ind., Ill. and Wis.		Group 4. Va., W. Va., N. C., S. C., Ia. and Fla.		Group 5. Ala., Miss., Ky., Tenn. and La.		Group 6. Mo., Ark., Tex., Kan., Colo., N. Mex. and Ind. Ter.		Group 7. Ia., Minn., Neb., S. Dak., N. Dak., Wyo. and Mont.		Group 8. Cal., Ore., Wash., Nev., Ariz., Utah and Idaho.	
	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.	Stock.	Bonds.
1882......	$31,590	$22,213	$59,108	$50,310	$25,936	$26,427	$20,773	$18,476	$21 920	$29 209	$25,067	$22,655	$28,891	$24,923	$37,572	$30,174
1883......	31,400	22.829	58,203	52,148	25 539	25,752	19,881	18 355	24,019	30.752	25,318	23.158	28.077	26.132	37.587	25.262
1884......	31,913	21,342	58,936	54.541	25.385	25 941	19,901	19,078	24.701	33.507	24.762	24,321	25.161	26,844	35,619	29 184
1885......	31,862	21.923	58,362	54,956	24,885	25.272	18.038	18,056	21,937	30.367	24,101	22,858	16,172	18 387	31,114	26,221
1886......	34,857	22,167	55,914	55.406	25,409	25,718	20.696	19,161	24.700	26.784	26,791	23.833	23,263	26,132	34.822	28,738
1887......	33,637	20,931	56,054	57,453	23,688	24.869	19,889	19,911	23.739	27.640	23,470	22,594	22,367	25.485	30,444	26,892
1888......	33.059	22,535	57.045	62,308	24.743	26,664	21.993	19 367	23,154	28.951	24,007	24.072	21,219	28,515	31,826	25.976
1889 ...	33.184	23,237	56,933	62,740	24,604	27,733	21,490	19,063	23,551	29 002	22 589	23,443	20,713	28,365	33,565	27,087
1890......	33,813	23.819	57,787	63.005	25,050	28,217	21,077	19,731	23.279	27.922	24,089	28,531	20.136	28,007	31,960	27.073
1891......	34,363	23.922	57,100	60,774	24.781	28.541	20,954	19,580	25,356	28.839	25,380	28.410	19.965	28.845	34,164	27,693
1892......	36,328	23,492	61,251	64,313	23,608	27.975	20,214	20,442	25,638	30,637	25 718	29,587	19,893	28,662	31 667	27,051

The second ventilating system will take air from the part of the basement underneath the power plant, where the steam pipes are most numerous and the heat most excessive. A partition divides this part of the basement from the main part. Ten 48-in. Blackman fans delivering through vertical pipes to the roof will be run by electric motors and will deliver about 20,000 cu. ft. per minute each. The air will enter the basement through openings in the floor, hence this quantity of 200,000 cu. ft. per minute will be added to that drawn out from the hall by the large fan.

The third system is designed to draw out the heated air from the boiler-room, and will be of the same capacity and general design as the second, viz., ten Blackman fans, furnished by the Exhaust Ventilator Co., of Chicago, delivering through vertical pipes to the roof. These fans absorb about 2½ HP. each, and are driven by electric motors of 4 HP., nominal. These fans are of the screw type and are mounted on a vertical shaft which is driven by the horizontal motor shaft by means of bevel gearing.

The design and erection of the whole plant is under the direction of Mr. Chas. F. Foster, Mechanical Engineer of the Exposition, and we are indebted to him for the information from which this description has been prepared.

STATISTICS OF RAILWAY OPERATIONS IN THE UNITED STATES.

(Concluded from page 100.)

The capitalization of the 161,275 miles of railway covered by reports to the Commission was on June 30, 1891, $9,829,475,015, and, on the assumption that the mileage for which no reports were made was capitalized at the same rate as the mileage covered by the reports, the total capitalization of the entire railway mileage of the country was $10,265,062,226. The total capitalization per mile of line was $60,942, or an increase of $602 per mile over 1890. The relative amounts of stock, funded debt and other forms of capitalization in each group of states (Fig. 1) is shown in the following table:

Group.	Per cent. of total group capital of. Stock.	funded debt.	Other forms indbt'ness.	P. c. of gr'p capt. to total Ry. capital.	Total capt. per mile of line.
I......	55.5	36.7	7.75	4.04	$59,391
II......	44.0	49.2	6.69	21.9	116,756
III......	44.7	50.1	5.16	13.8	64,920
IV......	46.4	48.1	5.44	4.62	46,123
V......	41.8	52.7	5.43	7.92	46,403
VI......	43.8	52.0	4.20	18.9	48,890
VII......	39.1	54.1	6.81	4.74	49,625
VIII......	44.0	50.4	5.62	10.9	53,258
IX......	44.3	50.8	4.85	3.30	34,153
X......	54.4	41.4	4.18	9.80	83,759
U. S....	45.3	49.2	5.48	100	$60,912

The figures of the table indicate that the increase in funded debt continues as for some years back to be relatively more rapid than the increase in stock. Thus, for the country as a whole, while stocks show a decrease of $598 per mile of line, notwithstanding the increase in mileage, funded debt shows an increase of $763 per mile, during the year covered by the report. By tracing back a few years, as is done in Table IV., compiled from Poor's Manual, it will be seen that it is only within the last 10 years that the funded debt has come to exceed the stock of railways in any large part of the country. At present the stock exceeds the funded debt in only two sections of the country, viz., the New England and the states west of the Rocky Mountains. In the former section this is due probably to the laws enacted in certain of the states with regard to corporate capitalization, but in the latter group the reason is not easily evident. It certainly connot be due to more conservative management.

As is well known, the capitalization of a railway property by no means indicates the value of that property as a source of income. The following table showing the total amounts of stocks and bonds which have borne interest at various rates is therefore of interest:

Per cent. div. and int. paid.	P. c. of total stocks.	Per cent. of funded debt. Bonds.	Misc. obligations.	Income bonds.	Total.
Nothing paid	59.6	3.94	25.4	66.8	9.9
1 to 2	1.42	. ..	.....	0.39	0 03
2 to 3	2.90	0.03	....	.....	0.03
3 to 4	3.57	0.28	0.96	.....	0.3
4 to 5	9.83	14.9	26 7	1.7	.15
5 to 6	8 53	31.6	26.3	26.1	30.8
6 to 7	5.11	33.7	13.3	1.82	29.9
7 to 8	4.59	14.9	7.13	3.22	13.5
8 to 9	2.06	0.44	0.3	.....	0.4
9 to 10	0.49	.....	.....	.....	.....
10 and above	1.86	0.03	. ...	.....	0.03
Total	100	100	100	100	100

No dividends were paid on nearly 60% of the total stock and 9.9% of the bonds. In this respect funded debt is showing a gain over previous years much greater than stock. With regard to mortgage bonds it will be seen that the showing is very good, but a very large percentage of miscellaneous obligations, by which is meant funded obligations which are liens on specified property in distinction to the road and franchises, and income bonds pay no interest. This is due to the fact that these last forms of indebtedness are closely allied to stocks, in that they permit the directors to disregard payments.

TABLE V.—Showing Earnings and Income Account by Territorial Groups.

Group.	Gross earnings per mile.	Percentage of gross earnings assignable to different traffic. Pass.	Mail.	Express.	Freight.	Other.	Net earnings per mile.	Net income per mile.	Total dividends per mile.	Surplus or deficit per mile.
I........	$11,204	45.4	1.6	2.43	49.9	0.89	$3,417	$1,774	$1 777	—3
II	15,356	25.	1.42	2.09	69.2	2.24	5 453	2,305	1,771	+534
III.......	7,910	25.1	2.58	1.95	68.4	1.95	2,425	813	658	+155
IV.......	4,339	26.6	3.24	1.66	66.3	2.16	1,446	310	281	+29
V........	4.854	24.9	2.42	1.92	68.1	2.74	1,507	216	298	—82
VI.......	5,426	23.9	2.46	1.81	69.5	2.18	1,945	621	467	+154
VII	4,575	23.1	3.68	1.96	69.5	1.64	1,667	248	306	—58
VIII.....	4.465	21.6	2.9	2.24	69 4	3.8	1,372	88	250	—162
IX.......	4,408	21.8	2.54	1.71	72.5	1.41	974	42	1	+41
X........	5,892	30.3	2.50	1.57	63.7	1.87	2,143	337	409	—72
U. S.....	$6,800	26.1	2.27	1.97	67.4	2.18	2,262	682	598	+84

TABLE VI.—Showing Operating Expenses per Mile of Railway in Each Territorial Division.

Group.	Oper. exp. per mile.	Percentage assignable to Maintenance of Way and structures.	Equipment.	Conducting transportation.	Miscellaneous.	P.c. assignable to Frt. traff.	Pas. traff.	P.c. opr. exp. to opr. income.
								69.5
I........................	$7,787	21.7	14.8	56.2	7.35	50.5	49.5	64.5
II..............	9,903	18.9	17.1	54.3	9.70	68.2	31.8	69.3
III...	5,485	19.2	17.5	52.9	10.3	68.4	31.6	66.7
IV........................	2,893	23.5	16 6	48.4	11.5	66.5	33.5	68.9
V........................	3,347	21.5	15.7	50.5	12.2	66.6	33.4	64.2
VI............	3,481	20.6	15.1	52.1	12.2	66.9	33.1	63.6
VII.......................	2.908	21.7	16.7	50.1	11.3	62.8	37.2	69 3
VIII......................	3,093	23.2	15.3	50.5	10.9	67.1	32.9	77.9
IX........................	3.434	26.5	13.1	51.6	8.79	71 6	28.4	63.6
X........................	3,749	24.6	14.4	51.3	9.73	59.9	40.1	66.7
U. S........................	$1,538	21.0	15.9	52.5	10.5	65.9	34.1	66.7

Traffic.—The totals of traffic for the year ending June 30, 1891, as given by the Commission's report, were as follows, as compared with the previous year:

	1891. 1 = 1,000	1890. 1 = 1,000
Passengers carried	531,183	492,430
" " one mile.......	12,844.243	11,817,785
" train mileage	307.927	285 575
Tons freight carried......	675,608	636,541
" " " one mile......	81.073,784	76,207.047
Freight train mileage................	446 274	435,170

A far more interesting table is that showing the passenger and freight train load, train mileage and passenger journey and freight haul, or, in other words, the density of traffic in different sections of the country. These are as follows:

Group.	Per mile of line. Pass. mileage.	Fr't ton mileage.	Passengers per pass. train.	Tons fr't per fr't train.	Av. pass. journey.	Av. length of haul per ton.
	1 = 1,000				miles.	miles.
I....	263	381	63	116.5	15.3	66 3
II....	196	1,386	48	236.4	17.7	108.9
III....	90	780	37	212.4	30	120.9
IV....	44	324	34	165.7	39.5	166.5
V....	43	311	30	140 3	38.3	112.2
VI....	54	425	36	177.6	29.9	124.4
VII....	42	241	39	142.2	87 4	180.9
VIII....	39	249	32	132.5	50.2	142.9
IX....	36	229	37	116.8	51.9	206.9
X....	72	229	58	133.9	35.9	190.
U. S....	79	503	42	181.7	24.2	120.
U. S., 1890	76	487	41	175.1	24.1	119.7

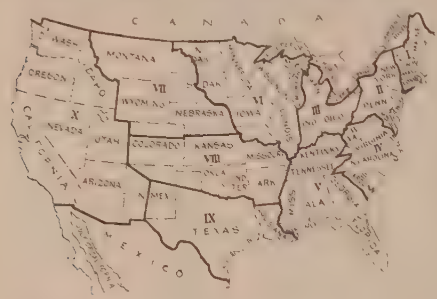
It will be seen that while the passenger train load has decreased, the freight train load has increased 6.6 tons over that of the preceding year. As in 1890, however, the freight train load was unusually small, 175.1 tons as compared with 179.4 tons in 1889; this large increase is not so significant as the figures seem to indicate. A good idea of the gradual growth in both freight and passenger train loads is obtained from the following tables rearranged from the Manual:

	Av. pass. train load passengers.	Av. dist. traveled per passenger.	Av. frt. train load, tons.	Av. haul, miles.
1882............	46.47	26.6	128.8	109
1883............	45.45	27.3	125.9	110
1884............	42.50	26.2	133.6	112
1885............	43.16	26	143.6	112
1886............	45.85	25.3	151	109
1887............	44.27	24.7	156.2	111
1888............	41.73	24.8	159.4	111
1889............	42 87	24.2	159.9	111
1890............	42.12	24.1	164	115
1891............	41.52	23.9	164.5	115
1892............	42.29	23.8	161.2	113

Earnings and Expenses.—The following is a condensed income account of the 161,275 miles of railway reporting to the Commission for the year ending June 30, 1891, compared with similar figures for the two years preceding:

	Per mile of railway. 1891.	1890.	1889.	Inc. or dec. of 1891 over 1890.	
Gross earnings	6,800	6,725	6,290	+	75
Operating expenses	4,538	4,425	4,203	+	113
Net earnings	2,262	2,300	2,087	—	38
Income from other sources	830	811	816	+	19
Total income	3,092	3,111	2,903	—	19
Surplus from operations	84	77	126	+	7

Income from operation or net earnings exhibit a decrease of $38 per mile during the year and the total income from all sources a decrease of $19. An increase of $7 per mile is shown in the surplus from operations, however. This increase in surplus, notwithstanding a relative decrease in income from operations, is due to an increase in income from other sources and to a relative decrease in the amount deducted from income from operation before the final net income is declared.



Subdivisions of the United States by the Interstate Commerce Commission's Statistician.

TABLE VIII.—Showing the Average per Mile of Stock, Bonds, Cost, and Earnings, Percentage of Expenses to Earnings, Earnings per Passenger Train-Mile and per Freight Train-Mile, per Passenger-Mile and per Tonnage-Mile, etc., for years 1886 to 1892 inclusive:

	1892.	1891.	1890.	1889.	1888.	1887.	1886.
Stock per mile of road	$28,680	$28,641	$28,333	$28,095	$28,768	$28,321	$29,935
Bonded debt per mile of road	31,845	31,179	31,241	30,178	29,972	28,290	29,062
Cost of road and equipment per mile of road	54,644	53,648	53,783	53,740	54,008	52 699	54,301
Pass. earnings per mile of road in oper	1,721	1,770	1,723	1,688	1,729	1,756	1,693
Fgt. earnings per mile of road in oper	4,787	4,591	4.651	4,333	4.397	4,649	4,397
Gross earnings per mile of road in oper	6 986	6,926	6,946	6,524	6 540	6,861	6,570
Net traffic earnings per mile of road in oper	2,068	2,168	2,195	2,095	2,045	2,444	2,376
Percentage of expenses to earnings	70.40	68.83	68.33	67.95	68.72	64.45	63.84
Pass. earnings per pass. train-mile	$ 0.906	$ 0.907	$ 0.920	$ 0.932	$ 0.937	$ 1.008	$ 1.006
Freight earnings per freight train-mile	1.559	1.528	1.5 2	1.550	1.557	1.615	1.573
Gross earnings per revenue train-mile	1.378	1.354	1.359	1.374	1.380	1 445	1.443
Gross expenses per revenue train-mile	0.970	0 932	0.929	0 934	0.948	0.931	0.921
Net earnings per revenue train-mile	0.408	0.422	0 434	0.440	0.432	0.514	0.522
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Pass. earnings—proportion of gross	24.63	25.84	25.24	26.13	26.44	25.82	25.77
Fgt. earnings—proportion of gross	68.52	67 00	68.12	67.13	67.24	68.38	66 94
Other earnings—proportion of gross	6 85	7.16	6.64	6.71	6.32	5.80	7.29
	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Earnings per passenger per mile	2.143	2.184	2.174	2.169	2.246	2.276	2.194
Earnings per ton per mile	0.967	0.929	0.927	0.970	0.977	1.034	1.042
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
Average distance per passenger	23.79	23.95	24.15	24.18	24.79	24.68	25.27
Average haul per ton	112.70	115.29	114.55	110.90	110.72	111.51	109.49
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Interest per cent. of bonds	4.25	4.25	4.27	4.40	4.35	4.71	4.75
Interest per cent. of bonds and debt	4.38	4.10	4.09	4.09	4.17	4.55	4.53
Dividends per cent. of stook	1.68	1.85	1.80	1.81	1.77	2.18	2.04
Interest and div. p. c. of stock, bonds and debt	3 01	3.06	3.04	3.03	3.03	3.40	3.26

The data given in Tables V. and VI. are of considerably greater interest, however, since they show the several sources whence the income arises and the classes of expenditures incident to the business of transportation in different sections of the country. It is noticeable that while the gross earnings per mile show a wide variation for different sections of the country, the percentage accruing from the different kinds of traffic runs very even throughout the country. Group I. (New England States) and Group IX. (Texas, Louisiana and part of New Mexico) are the only exceptions, passenger earnings predominating in the former and freight earnings in the latter. The same uniformity is observable in a less degree in the percentages of operating expenses assignable to various classes of expenditures.

Table VII., showing the cost and revenue per unit of passenger and freight traffic, indicates that the forces at work to reduce the revenue per unit of work are as active as ever. In commenting upon this point the Commission's statistician says:

TABLE VII.—Showing Cost and Revenue per Unit of Traffic in Each Territorial Group.

Group.	Per passenger-mile. Revenue. Cts.	Cost. Cts.	Profit. Cts.	Per passenger train-mile. Revenue. $.	Cost. $.	Profit. Cts.	Freight per ton-mile. Revenue. Cts.	Cost. Cts.	Profit. Cts.	Per freight train-mile. Revenue. $.	Cost. $.	Profit. Cts.
I	1.890	1.465	0.425	1.319	0.923	39.61	1.439	1.0 0	0 409	1.707	1.200	50.7
II	1.893	1.618	0.275	1.069	0.783	28.64	0.760	0.479	0.281	1 805	1.135	67.0
III	2 161	1.931	0.230	0.784	0.718	6.6	0.690	0.477	0.213	1.474	1.014	46.0
IV	2.466	2.073	0.393	1.037	0.730	30.69	0 852	0.562	0 290	1.449	0.954	49.5
V	2.501	2.284	0.217	0 980	0.747	23.29	1.018	0.690	0.328	1.471	0.993	47.7
VI	2.281	2.066	0.215	0.979	0.727	25.22	0.858	0.532	0.326	1.512	0.932	57.9
VII	2.501	2.594	0.083	1.189	0.977	21.21	1.333	0.759	0.574	1.845	1.050	79.5
VIII	2.377	2.553	*0.076	0.942	0.807	13.53	1.217	0.814	0.403	1.611	1.077	53.4
IX	2.587	2.644	*0.057	0.789	0.984	*19.46	1.363	1.051	0.512	1.632	1.256	37.6
X	2.328	2.053	*0.975	1.626	1 208	41.76	1.631	0.971	0.660	2.184	1.297	88.6
U. S., 1891	2.142	1.910	0 232	1 061	0.804	22.65	0.895	0.583	0 312	1.636	1 061	57.5
U. S., 1890	2.167	1.917	0.250	1.080	0.809	27.10	0.941	0.604	0.337	1.654	1.057	59.7
1889	2.165	1.993	0.172	1.062	0.830	23.00	0.922	0.593	0.329	1.653	1.064	58.9
1888	2.349	2.042	0.307	1.139	0.846	29 3	1.001	0.630	0.371	1.657	1.038	61.9

* Loss.

> The most important factor in bringing about decreased charges is doubtless the increase in the volume of traffic, for the business of transportation is peculiar in this, that economy of management is more directly dependent on volume of traffic than in ordinary business. The number of passengers carried has increased since 1889 from 472,171,343 to 531,183,998, and the number of tons of freight carried has increased from 539,639,583 to 675,608,323. Here is indeed a broad margin for the practice of economies. It is increase in business which permits the railways to reap increased revenue at decreased rates.

There is, however, some reason to believe that decrease in charges has proceeded with relatively greater rapidity than the increase in economies. By comparing the revenue and cost per train-mile it appears that the decrease in revenue during the three years previous to June 30, 1891, was 3.374 cts., while the decrease in cost was 0.343 ct. This divergence between cost and revenue per train-mile is most marked in the passenger revenue, the decrease in revenue per passenger train-mile since 1888 being 7.841 cts. as against a decrease of 4.238 cts. in cost of running passenger trains. These figures show a remission of charges to the public for service rendered greater than is warranted by increase in the volume of traffic.

In connection with the several tables covering operations and revenue already given, table VIII., from the introduction to Poor's Manual for 1893 is of interest:

Accidents.—According to the Commission's report, a greater number of casualties has happened to both employees and passengers during the year ending June 30, 1891, than during any previous year covered by the reports to the Commission. The number of persons killed and injured by railways during the four years ending June 30, 1891, are given as follows:

	1891. Kld.	Inj.	1890. Kld.	Inj.	1889. Kld.	Inj.	1888. Kld.	Inj.
Employees	2,660	26,140	2,451	22,396	1,972	20,028	2,070	20,148
Passengers	293	2,972	286	2,425	310	2,146	315	2,138
Other persons	4 076	4,769	3,598	4,206	3,541	4,135	2,897	3,602
Total	7,029	33,881	6,335	29,027	5,823	26,309	5,282	25,888

If the casualties for the year covered by the present report be compared with those of the previous year as in Table IX. it will be seen that, with the exception of the number of passengers killed, there has been a relative as well as an absolute increase in casualties resulting from railway

Table 10.—Comparative Danger of Railway Travel and Service in Different Sections of the Country.

Employees.	States east of Ill. and north of Ohio & Potom'c Rivers.	States south of Ohio & Potom'c and east of Miss. River.	States west of Ind. and lower Mississippi River.	United States.
No. of for one killed	303	206	332	296
" " injured	32	17	36	30
Trainmen:				
No. of for one killed	113	60	118	104
" " injured	11	16	14	10
Passengers:	1 = 1,000	1 = 1,000	1 = 1,000	1 = 1,000
No. carried for one killed	2,751	677	1,077	1,811
No. carried 1 mile for one killed	52,264	26,269	40,087	43,789
No. carried for one injured	301	72	91	178
No. carried 1 mile for one injured	5,729	2,812	3,410	4,317
Percentage of employees killed through various causes.				
Collisions	9.70	15.04	11.89	11.39
Derailments	3.96	13.14	10.33	7.75
Other train accidents	2.64	2.12	1.44	2.14
Total " "	16.20	30.30	23.66	21.28
Coupling and uncoupling	14.21	16.74	17.	15.6
Falls from trains and engines	22.98	23.09	21.44	22.48
Overhead obstructions	2 95	3.39	2.67	2.93
Other causes	38.2	23.94	27.89	32.18
Percentage of employees injured through various causes.				
Collisions	5.86	6.47	5.67	5.93
Derailments	1.76	5.75	4.56	3.52
Other train accidents	1.25	1.56	0.94	1.22
Total " "	8.87	13.78	11.17	10.67
Coupling and uncoupling	40.97	36.11	28.97	36.08
Falls from trains and engines	11.26	12.96	13.08	12.2
Overhead obstructions	1.73	1.89	1.14	1.58
Other causes	34.33	28.62	36.6	33.82

TABLE IX.—Summary of Accidents to Persons on Railways of the United States for Year Ending June 30, 1891.

	Employees.										Others.							
	Trainmen.		Switch, flag and watchmen.		Other employees.		Total employees.		Passengers.		Trespassing.		Not tresp.		Total.		Total, all classes.	
	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.
Coupling and uncoupling	288	7,155	111	2,044	16	232	415	9.431	......	......	......	......	......	......	......	......	415	9.431
Falling from trains	467	2,491	55	300	76	397	598	3,191	......	......	......	......	......	......	......	......	598	3,191
Overhead obstructions	72	357	3	25	3	30	78	412	......	......	......	......	......	......	...	......	78	412
Collisions	230	1,189	5	55	68	306	303	1,550	59	623	49	48	28	72	77	120	380	1,670
Derailments	168	686	6	47	32	186	206	919	49	837	17	52	9	29	26	81	232	1,000
Other train accidents	40	268	2	11	15	40	57	319	2	34	21	41	......	8	21	49	78	308
At highway crossings	3	15	11	19	6	16	20	50	3	8	167	162	394	693	561	855	581	905
At stations	32	450	17	79	78	898	127	1,427	40	461	304	419	73	180	377	599	504	1,926
Other causes	233	2,807	91	439	532	5,595	856	8,841	140	1,009	2,907	2,804	107	261	3,014	3,065	3,870	11,906
Total, 1891	1,533	15,421	301	3.019	826	7.700	2,660	26,140	293	2,972	3,465	3.526	611	1,243	4,076	4,769	6.736	30.909
Total, 1890	1,459	13,172	234	2,307	731	6.681	2,451	22,396	286	2,425	3,062	3,012	509	1,131	3,598	4,206	6,335	26,602

accidents. The number of employees killed during the year was 2,660, an increase of 9% over the number killed in 1890, and the number injured was 26,140, an increase of 17%. The increase in the number of employees during the year was 5%. The increase in the number of passengers killed was less than 1%, but the increase in the number injured was 22%. The increase in the number of passengers carried was 8%, showing that there was a relative decrease in the passengers killed, but a large relative increase in the number injured. The large number of accidents resulting from the coupling and uncoupling of cars is especially noticeable in this table. The casualties from this source alone amount to 34% of the total casualties to employees. A very large proportion of the casualties to employees is the result of falling from engines and trains. The full significance of these figures lies in the fact that they are almost all due to the lack of safety devices; that is, automatic brakes and couplers. Further reference to the table also shows that the number of casualties from collisions is very large; in fact, this is far the most serious of all train accidents. It is almost needless to say that the most of these could be done away with by the adoption of a block system of handling trains. The need of a better system of train movement is apparent in the Eastern as well as the Southern and Western states, as will be seen from the figures giving the percentages of employees killed in collisions in Table 10. Another point to be noted in this table is the large proportion killed by derailments in the Southern and Western states. The poorer roadbeds in these sections are undoubtedly responsible for this.

THE BASIN CREEK DAM FOR THE WATER-WORKS OF BUTTE, MONT.

By Eugene Carroll, Constructing Engineer.

The dam under construction by the Butte City Water Co. is situated about 13 miles due south of Butte, Mont., and dams the water of Basin Creek at its junction with Bear Creek.

The dam is a masonry structure of 120 ft. extreme height, designed by Chester B. Davis, M. Am. Soc. C. E., of Chicago, Ill. It will have an extreme length of over 300 ft. along the top, and is built on a curve, having a radius of 350 ft. for the inner face. The dam is constructed of large stone, with spaces between thoroughly filled with concrete. A view of the dam under construction is shown by Fig. 1.

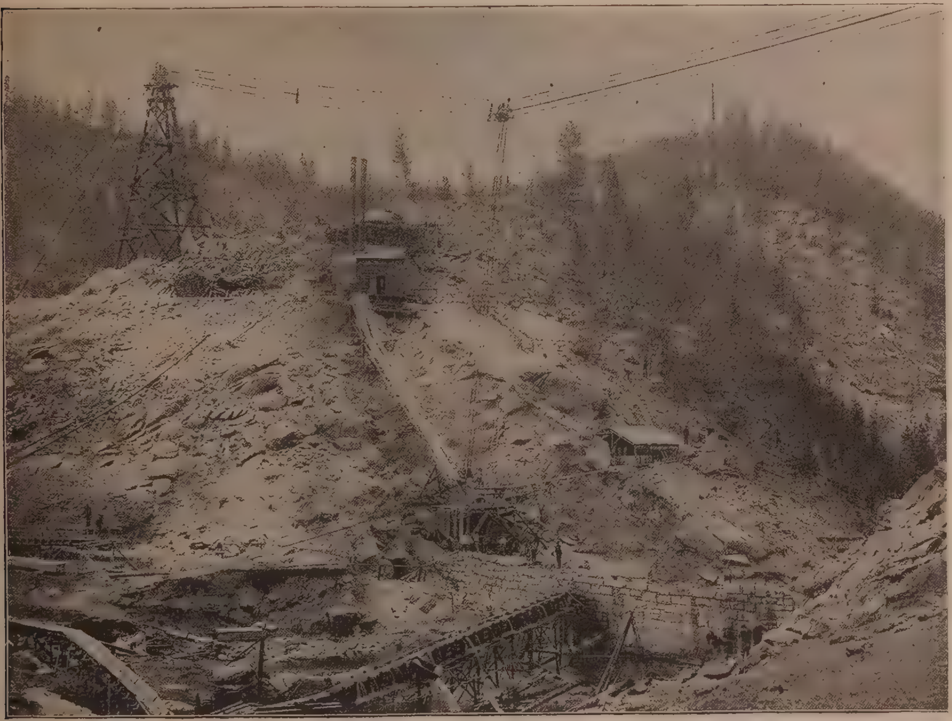


FIG. 1, VIEW OF BASIN CREEK DAM UNDER CONSTRUCTION ; BUTTE CITY WATER CO., BUTTE, MONT.

The Lidgerwood Mfg. Co. furnished one of their Locke-Miller cableways, which was erected and put in operation on Sept. 13, 1892. The main cable is 2¼ ins. in diameter, and has a clear span of 892 ft. between towers, with a carrying capacity of six tons. The west tower is 80 ft. high and the east tower 15 ft. This length of cable was made necessary from the fact that our main quarry is on the east side, and, as will be seen by reference to the profile, Fig. 2, this cableway spans the quarry, so that the stones are taken directly from the place in which they are quarried, and delivered directly to the dam, without further handling. Another feature that will be noted is the placing of the hoisting engine between the towers, thus enabling the engineman to see the work. The Lidgerwood company advised the placing of the hoisting engine behind the tower, but there were so many advantages in placing it in its present position that I decided to take the responsibility, and have been amply repaid for it; it enables the engineman to keep his load in sight at all times, and the masonry foreman to set his stone by hand signals, thus reducing to a minimum the chances of misunderstanding signals. In setting, a mortar bed is first prepared, and the stones, ranging in size from ½ to 1½ cu. yds. volume, are set as easily and as accurately as they could be with a hand derrick.

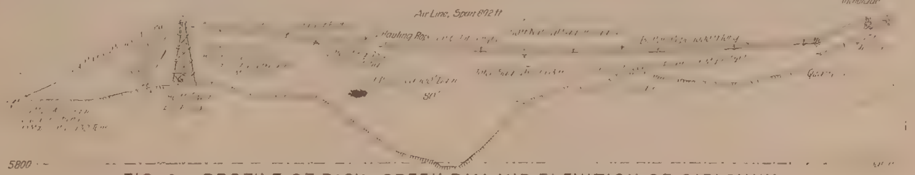


FIG. 2. PROFILE OF BASIN CREEK DAM AND ELEVATION OF CABLEWAY.

The cable is stretched on the chord of the inner face, and the original intention was to simply use it for bringing in the stone and placing them on the dam, to be picked up and set by hand derricks. Owing to the narrow space to work on, however, it was inconvenient to use derricks, and the method of using a snubbing post and horse, shown by Fig. 3, was tried with gratifying success. By this device we are enabled to set the stone by the cableway, on any part of the dam, without the use of derricks; and as we have succeeded in keeping all the men at work possible in allotted space, a criticism which might be made that the work must progress slowly on account of the fact that the cableway is not performing any carrying at the time it is setting stone is refuted.

We have found by actual experience that while the masons are filling the joints on a face course, the cableway easily covers the back part of the dam with large rock, so there is plenty of room to keep the concrete mixer running at full capacity, while the cable is setting the next face course. Thus, by alternating from face course to backing, the whole work is kept rapidly progressing, and all the men it is possible to work are kept busy; at the same time the cableway and concrete mixer are kept constantly at work, which gives the greatest economy of construction. The speed, in my opinion, could not be increased except by duplicating the whole plant, by placing another cable parallel to the present one, with another concrete mixer, and this is impracticable, owing to the confined working space.

Unfortunately it was impossible to take a photograph which would show the horse and snubbing post, although the ropes going to the horse and post are to be seen in the photograph, Fig. 1, and the device is shown in the sketch, Fig. 3.

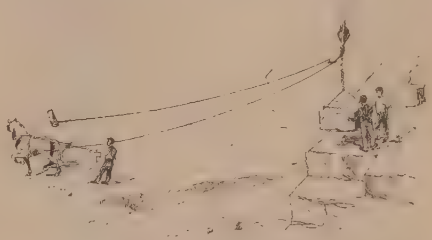


Fig. 3. Snubbing Post.

The company decided to construct the dam only to the elevation 5,815 during 1892, so the lines were drawn in for a dam of that height, and owing to the contracted working space we were unable to make as good a record of quantity of masonry laid as I have good reason to believe we can do. Work was stopped on June 17, after having placed 4,345 cu. yds. of masonry. During the 16 days of June we placed 1,430 cu. yds. of masonry, with an average of 86 men altogether, which number included six masons besides the quarrymen, firemen and all labor employed about the dam and camp. This is an average of nearly 15 cu. yds. of finished work per day to each mason, or a little over 1 yd. per man of all men on the payroll.

The cableway was not erected until after the excavation for the foundation was completed, and I am confident that we could have saved 30% of the cost of this excavation had it been erected before starting the work. After nearly three months of constant work, the only repairs necessary are a set of sheaves for the carrier.

It is our intention to allow the water to rise in the reservoir as the dam progresses, and we have built a large barge with which we intend to pick up rock around the reservoir, and boat them down to the dam, where they can be lifted by the cableway.

We have had occasion to move our concrete mixer once since construction, and we picked it up with the cableway and lifted it out of the way one evening after working hours, built a new foundation and set it back again, the whole operation of moving and replacing consuming less than two hours, whereas without the cableway it would have consumed probably a day or more.

The numberless little things which are performed by the cableway, such as moving machinery and tools, besides its principal use of delivering material, aggregate in the whole quite a saving in expense.

It may be of interest to add that the Lidgerwood Mfg. Co., as we learn, has sold cableways for the construction of four irrigation dams within the last two or three months, as follows: Two to the Bear Valley Irrigation Co., Redlands, Cal.; one to the Aqua Frio Construction Co., Phoenix, Ariz.; and one of 1,500 ft. span to the South Gila Canal Co., Sentinel, Ariz.—Ed.

MEASURING BRIDGE AND FLOOR VIBRATION BY PHOTOGRAPHY.

Professor Steiner, of Prague, has been measuring the vibration of parts of a bridge by photography and has established the characteristics of a number of them. As one result he finds that on an unloaded span of 140 ft. a locomotive, with wheels 4 ft. in diameter and moving at the rate of 25 miles per hour, produces dangerous vibrations.

His process is a delicate one and is an application of the chrono-photographic process of Mr. M. E. J. Marey, of the Institute of France. He uses little glass balls from 3 to 4 centimeters in diameter, says "Le Genie Civil;" and these are strongly illuminated either by a solar ray, or by an electric arc light or a magnesium light. These balls give upon a photographic negative a clear and well defined point. To register vibrations, one of these glass balls is fixed at the point to be examined and the photographic apparatus is then so set up that the image of the ball falls on the right edge of the plate. The plate is exposed at the moment the movement commences and at the same time the camera is turned from right to left on a pivot. The negative then shows an undulating line which is the vibrations of the ball point in amplitude and duration.

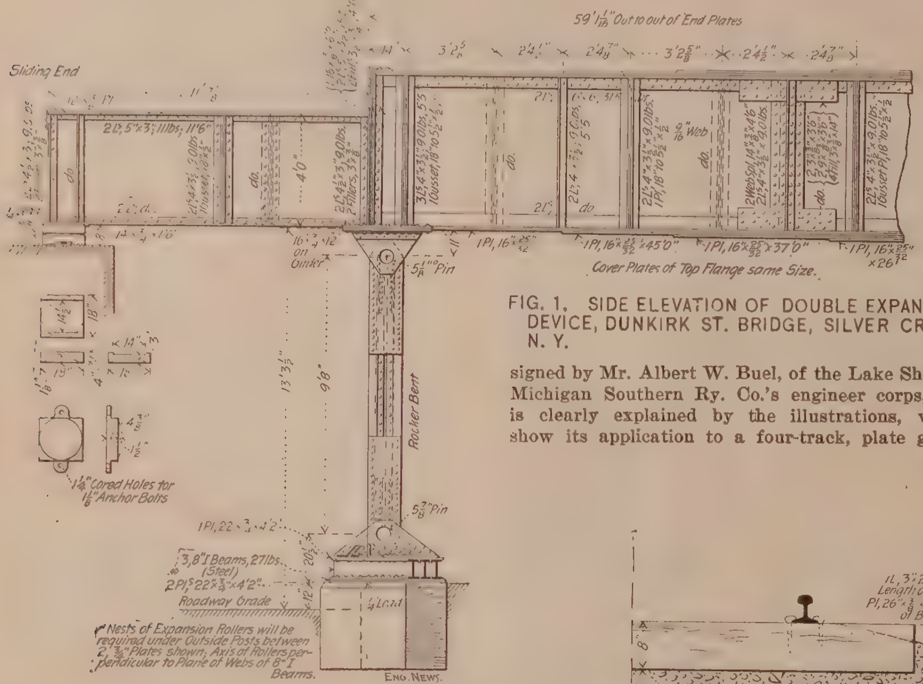
To obtain a scale with which to read this undulating line, a second ball is suspended to a fixed point, to which is given a known rate of oscillation. The position of these two balls is such that their images coincide in a state of rest and a comparison of the trace of the second ball as printed upon the line of the first on the negative gives the number of vibrations of the latter in a given time.

It is possible then to place near the first ball a fixed scale brilliantly illuminated like the ball itself, and as this scale appears on the negative the amplitude of the oscillations can be measured at a glance. The measurements may be made either directly upon the print, or from an enlargement made in the usual manner.

To avoid the practical difficulty of making the images of the two balls coincide at the beginning of the operation, Professor Steiner says a pendulum may be made to oscillate before the source of illumination of the ball. The ball of this pendulum will pass before the light at regular and determined intervals and the undulating line on the negative will be broken at distances corresponding to the duration of an oscillation of the pendulum. It is not important that the camera turns upon its axis with a uniform motion and the speed of turning is likewise of little importance. The relations of the curves traced by the two balls will always remain the same. It is suggested that an apparatus of this kind would be useful in studying the vibration of the floors of buildings resting for some years on iron beams, especially when these floors are submitted to the rhythmic shock of dancing.

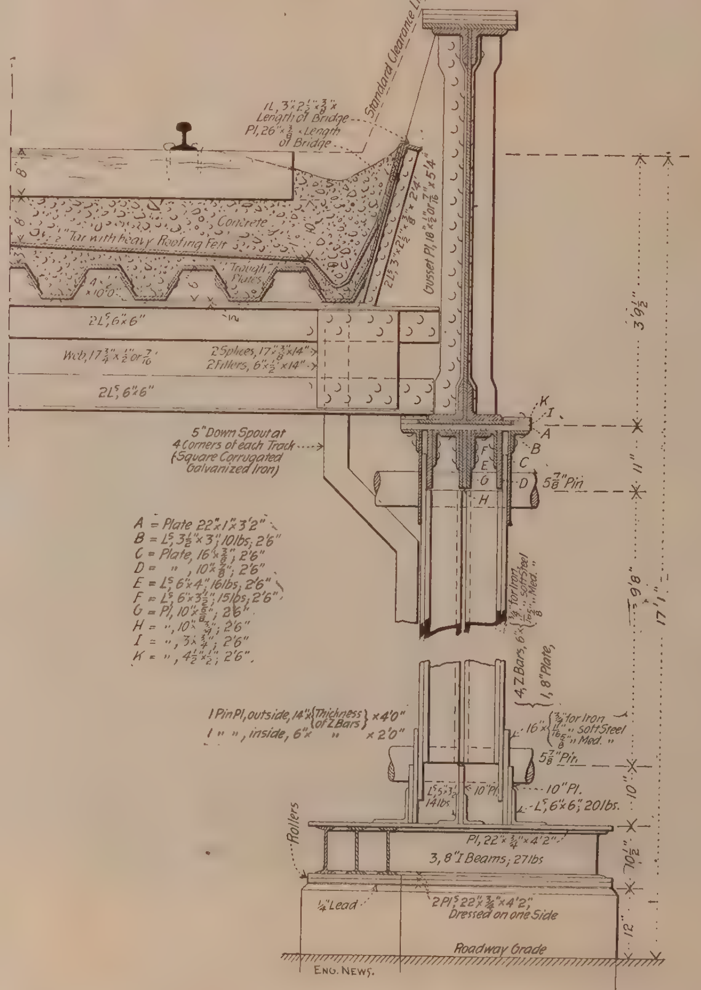
A DOUBLE EXPANSION DEVICE FOR BRIDGES.

We illustrate in the accompanying cuts details of an interesting device designed to allow both longitudinal and transverse expansion in wide, short span railway bridges. This device was designed by Mr. Albert W. Buel, of the Lake Shore & Michigan Southern Ry. Co.'s engineer corps, and is clearly explained by the illustrations, which show its application to a four-track, plate girder bridge on the line of the above-mentioned railway, at Dunkirk St., Silver Creek, N. Y. A part side elevation is shown in Fig. 1 and a sectional end elevation in Fig. 2. As will be seen, the device consists simply of a rocker bent made up of vertical posts, one under each girder, connected by horizontal and diagonal transverse bracing, resting on roller bearings whose travel is perpendicular to the swing of the bent. To equalize the pressure on the masonry of the abutments the girders rest on spherical bearings. The section, Fig. 2, also shows the type of solid floor used on recent bridges on this line. The contractor for the iron-work was the Union Bridge Co., of New York, N. Y.



59' 1/16" Out to out of End Plates
Sliding End
2L; 5"×3"; 11lbs; 11'6"
do
do.
4'0"
Web
Rocker Bent
13'3 1/2"
9'8"
5 1/8" Pin
5 7/8" Pin
16"×3/4"×12" on Girder
1Pl, 16"×25/32"
1Pl, 16"×25/32"×45'0"
1Pl, 16"×25/32"×37'0"
1Pl, 16"×25/32"×26'
Cover Plates of Top Flange same Size.
1 1/4" Cored Holes for 1 1/8" Anchor Bolts
1Pl, 22"×3/4"×4'2"
3, 8" I Beams, 27lbs. (Steel)
2Pl; 22"×3/4"×4'2"
Roadway Grade
1/4" Lead
Nests of Expansion Rollers will be required under Outside Posts between 2, 3/4" Plates shown; Axis of Rollers perpendicular to Plane of Webs of 8" I Beams.
Eng. News.

FIG. 1. SIDE ELEVATION OF DOUBLE EXPANSION DEVICE, DUNKIRK ST. BRIDGE, SILVER CREEK, N. Y.



Standard Clearance Line
1L, 3"×2 1/2"×3/8"× Length of Bridge
Pl, 26"×3/8"× Length of Bridge
Concrete
Tar with heavy Roofing Felt
Trough Plates
Gusset Pl, 18"×1/2" or 7/16"×5'4"
2L; 6"×6"
Web, 17 3/4"×1/2" or 7/16"
2 Splices, 17"×3/8"×14"
2 Fillers, 6"×1/2"×14"
5" Down Spout at 4 Corners of each Track (Square Corrugated Galvanized Iron)
A = Plate 22"×1"×3'2"
B = L; 3 1/2"×3"; 10lbs; 2'6"
C = Plate, 16"×3/8"; 2'6"
D = " , 10"×7/8"; 2'6"
E = L; 6"×4"; 16lbs; 2'6"
F = L; 6"×3 1/2"; 15lbs; 2'6"
G = Pl, 10"×5/8"; 2'6"
H = " , 10"×3/4"; 2'6"
I = " , 3"×3/4"; 2'6"
K = " , 4 1/2"×1/2"; 2'6"
5 7/8" Pin
3'9 1/2"
11"
9'8"
17'1"
4, Z Bars, 6"
1, 8" Plate
1 Pin Pl, outside, 14"×(Thickness of Z Bars)×4'0"
1 " ", inside, 6"× " ×2'0"
16"×3/4" for Iron, 11/16" " Soft Steel, 5/8" " Med. "
10" Pl.
L; 6"×6"; 20lbs.
L; 5"×3 1/2"; 14lbs
Rollers
Pl, 22"×3/4"×4'2"
3, 8" I Beams; 27lbs
1/4" Lead
2Pl; 22"×3/4"×4'2"; Dressed on one Side
Roadway Grade
10"
10 1/2"
12"
Eng. News.

FIG. 2. SECTIONAL END ELEVATION OF DOUBLE EXPANSION DEVICE, DUNKIRK ST. BRIDGE.

THE RESERVOIR BREAK AT PORTLAND, ME.

The following account of the break in the reservoir of the Portland Water Co., at Portland, Me., which occurred Aug. 6, as noted in our issue of Aug. 10, was sent us by Mr. Percy H. Richardson:

The reservoir is situated on Mountjoy Hill, within the city, at the northwest corner of North and Walnut Sts. From this corner the land slopes rapidly toward Casco Bay, a fall of about 110 ft. in a little over an eight of a mile. On the same side of Walnut St. and in the shadow of the reservoir, were two houses with stables. A plan of the reservoir and the vicinity of the break is shown by Fig. 1, and a view of the break by Fig. 2. The reservoir was built in 1889 by Contractor J. J. Newman, of Providence, from plans by J. Herbert Shedd, M. Am. Soc. C. E., of the same place, and the work was under the direct charge of one of Mr. Shedd's experienced assistants. The original estimate of cost was $72,000, but the stripping of the surface soil developed unexpected springs and pockets of quicksand, and, warned by the break in their reservoir at the other end of the city a few years before (June 9, 1882), no expense was spared to overcome the difficulties, and the final cost was about $125,000.

In the construction the earth was stripped to a depth of about 3 ft. below the natural surface to hardpan. The draw-off pipe, was laid in a trench dug in this hardpan with cut-off walls of concrete at each joint. The inner half of the embankment, as indicated in the cross-section, Fig. 1, was of selected material thoroughly puddled, the inner 6 ft. being of clay. The entire embankment, from inside to outside, was well rolled with a heavy gridiron roller. The overflow pipe was carried up with the wall and every precaution taken to puddle thoroughly about it. Its mouth was surrounded by a 7-ft. mass of concrete well bonded with the clay puddle. One main pipe served to connect the drain and overflow with the sewer, the overflow trapping into the main pipe just below the gate of the drain. The capacity of the reservoir was 20,000,000 gallons.

At 5:30 a. m., Sunday, Aug. 6, two women, in passing, discovered "a stream of water bubbling quite forcibly from the ground at the foot of the reservoir," and just above the Walnut St. houses. They aroused the people in the houses and all should have been saved, but for some unaccountable reason a woman and her two daughters, living in the lower house, went back into the house, and with a young man who tried to save them were buried in the wreck when the side of the reservoir came out, letting loose with a rush some 17,000,000 gallons of water almost directly upon the houses. A press report says, that as young Mosely dashed into the house "the stream of water had now become a torrent, and the next instant it was an avalanche.." "It sounded as if the paving stones from the inside lining of the reservoir were being hurled against those houses in a constant bombardment," said one of the eyewitnesses.

The force of this torrent only scoured out the surface soil to a depth of about 3 ft. or possibly 4 ft., but the material tamped into the trench of the draw-off pipe was carried out nearly to the pipe, the stem of the gate being just below the surface of the water in Fig. 2, which shows plainly the cutting out of the old trench. It may not have scoured to the pipe at the inner end, the concrete cut-off probably saving this, but it must have cut well down to these concrete walls, and good evidence as to the quality of the material used in the construction is found in the fact that even with the terrific impetus of 17,000,000 gallons under 30 ft. pressure, the flood was stemmed by an artificial dam, formed by the falling puddle and cobble stones, and probably aided by the concrete cut-off, which held the water back to a depth of nearly 10 ft. This dam is shown in the center of the break, in Fig. 2. Another proof that the material was good puddle lies in the fact that even near the reservoir where the 17,000,000-gallon stream was acting through a narrow break, it only cut to a depth of 4 ft., hardly entering the subsoil used for puddle, while 400 ft. below the reservoir the surface is hardly broken. The mouth of the overflow, with the mass of concrete in which it was embedded, was deposited about 200 ft. from the reservoir.

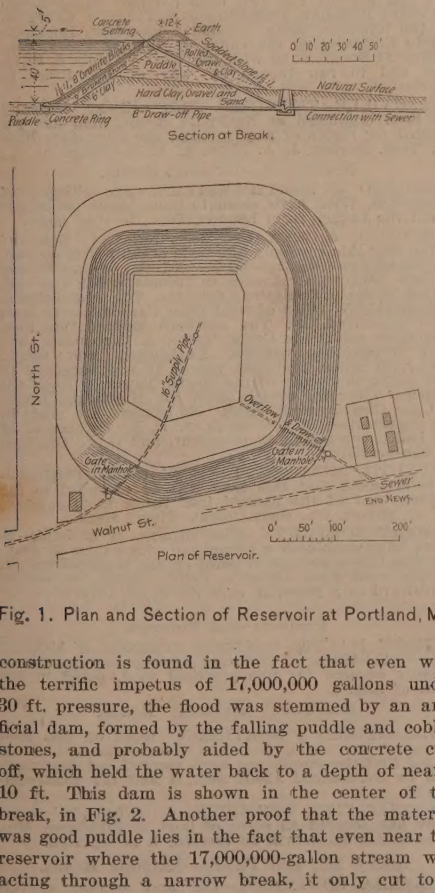


Fig. 1. Plan and Section of Reservoir at Portland, Me.

Two hours after the break some of the granite paving on the side of the reservoir nearest Walnut St. slid in. This slide has a depth of about 3 ft. The opposite side began sliding the next day, but the other two sides still stand (Aug. 12), although it is feared they will give way when the water is withdrawn, as is being done now.

The water company has had the break examined by Messrs. J. Herbert Shedd, M. Am. Soc. C. E., of Providence; J. J. R. Croes, M. Am. Soc. C. E., of New York; Wm. Jackson, M. Am. Soc. C. E., of Boston, and E. C. Jordan, M. Am. Soc. C. E., of Portland, Me. Mr. J. R. Freeman, M. Am. Soc. C. E., of Boston, who represented the coroner, was also in the party. All agree that the embankment was built of first-class material, and well built, if the break is a fair sample of the construction. While the inquest is secret, it is known that, though nothing is certain, it is more than probable that the break was along the overflow pipe. Mr. Jordan is reported in the papers as testifying that, in his opinion, the break was caused by the action of frost. Last winter the water was often lowered to the 20-ft. level and Mr. Jordan thinks that the bond between the mass of concrete and the mouth of the overflow and the puddled wall was broken by the frost and attributes the long interval since taken by the water to work its way along the overflow pipe to an outlet, to the fine construction and thorough puddling of the wall. This, in my opinion, is the most plausible theory yet advanced, and is one of the two also advanced by Mr. Shedd, whose second theory is that there may be something in the report that, the Friday before the break, lightning struck the reservoir following the overflow and breaking a pipe or joint. Mr. Shedd says that to his mind "the cause of the accident can only be conjectured," and gives these two theories as the most plausible conjectures.

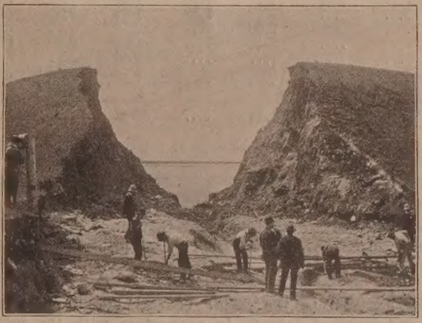


Fig. 2. View of Break in Reservoir,

(The distance across the reservoir is greatly exaggerated by this view. The actual distance from the foreground of the view to the crest of the further embankment is only about 500 ft.)

It is estimated that it will cost $25,000 to repair the break, and suits for damages may make the loss a great deal heavier.

Since the above was put in type we have received from Mr. J. P. Frizell, M. Am. Soc. C. E., an account of the failure with some interesting comments upon it. Mr. Frizell's communication, with the omission of some of the details already given, is as follows:

The reservoir of the Portland Water Co. was built to supply the low districts of the city of Portland, Me. Its general shape is shown in the accompanying sketch (see Fig. 1). The work was in excavation to the depth of some 30 ft. on one side and about 6 ft. on the opposite side, the material being a stiff, clayey gravel. At the point where the rupture took place, the substratum was a very refractory hardpan, which was not worn away to the depth of more than 12 ins. by the full force of the water during the time of emptying. The body of the embankments was of material taken from the excavation and from borrow pits in the immediate vicinity. It was very thoroughly compacted, as it showed by standing at a nearly perpendicular face after the break, till thrown down by the workmen to avoid accident. On the interior slope was a 6-ft. layer of puddle, formed of clay taken from a neighboring clay pit mixed with sand or gravel. It was spread in 6 to 9 in. layers and heavily rolled. A 6-in. layer of fine broken stone was placed on this puddle, and on this was laid a 9-in. (or 8-in.?—Ed.) pavement composed of granite blocks about 12 ins. square. The top of the embankment, including these several layers, was about 12 ft. wide. It is understood that the reservoir had been in use four years. It was remarkably tight, no evidence of leakage being visible.

An angle of the work occupied the lowest point of the natural site. In this angle were laid the overflow pipe for controlling the height of water in the reservoir, and the drain pipe for drawing off the water. A section along the line of these pipes is shown in Fig. 1. The overflow was a 12-in. cast iron pipe, starting from a mass of concrete at the water level of the inner slope and discharging at the foot of the outer slope. The drain was an 8-in. cast iron pipe laid at the level of the reservoir bottom with a slight inclination, in a trench excavated in the natural soil.

Shortly after the accident, something like 100 ft. of the puddle layer and pavement at the obtuse angle sloughed down and slid 20 ft. or more. A few hours later it was followed by about an equal length on the opposite side. The other two sides showed considerable bulging and distortion, but did not slip.

The failure of an important hydraulic structure, though unfortunate for its owners and vexatious to its designers and constructors, often carries with it some compensation in the form of lessons for future guidance in similar undertakings. It were, indeed, an ominous and portentous fact for the engineering profession, if no cause could be assigned for such a catastrophe. It would imply that engineering it not an exact science, and that it is not possible for the engineer of such a work to guarantee its permanence, even when intrusted with all the means and resources that he considers essential to that end.

To my mind, the cause of this disaster is not far to seek. A slope of 1½ base to 1 perpendicular, both inside and out, is, it must be conceded, the extreme limit of steepness for hydraulic embankments, even when combined with a considerable width at the top. In this case, if we exclude the layers of pavement, broken stone and puddle, there was practically no width at the top. That these several layers contributed nothing to the stability of the embankment is manifest from the fact that they slipped from their place as soon as relieved of the sustaining pressure of the water. On the contrary, these layers, by reason of the pasty and semi-fluid condition manifestly assumed by the puddle while under water, were an addition to the fluid pressure on the bank.

Undoubtedly, such a bank as this, considered as of indefinite length, or as serving to close a natural ravine, would have had sufficient strength; but it would have undergone some change of form under the action of the pressure. Some slight displacement of the upper part of the embankment, in the direction of the pressure, would have occurred. No structure, mass, or combination of material resists pressure without some change of form. It is in virtue of such change that its power of resistance is developed.

The rupture took place at an angle, the junction of two contiguous banks, which had here their maximum height of something like 44 ft. It is obvious that, at this point, the banks could not undergo the deformation necessary to the development of their full strength without a strong tendency to separate along the diagonal forming their line of junction. This tendency was favored by the trench for the drain pipe, interrupting the continuity of the natural formation at the base of the embankments, as well as by the introduction of the overflow pipe in the same vertical plane. Any supposition of the creeping of water along these pipes and gradual wearing of an outlet is inadmissible. This would imply a long, continued discharge which could not have failed to be observed. The extreme suddenness of the disaster implies a sudden yielding of the banks and the sudden opening of a passage for the water.

The lesson of this disaster appears to me simple and obvious, viz.: That hydraulic embankments of this height should have a stronger cross-section. That a slope of 1½ to 1 is too steep for face puddle was shown at the Lowell Reservoir, which had this slope on the inside. The reservoir, in October, 1883, being emptied for cleansing, large masses of the pavement and broken stone slid bodily into the reservoir, large areas of pavement laying flat on the bottom with little derangement of the stones.

STATUS OF STREET PAVING IN KANSAS.

The table here given, showing the amount and cost of street paving in the principal cities and towns of Kansas, was compiled by Prof. E. C. Murphy, of the Kansas University, from answers obtained from the city engineers. The table itself is published in the "Kansas University Quarterly."

	Stone block		Asphalt.		Wood block and concrete.		Brick.		Broken st'ne		
	Miles.	Cost per sq. yd.	Miles.	Cost per sq. yd.	Miles.	Cost per sq. yd.	Miles.	Cost per sq. yd.	Miles.	Cost per sq. yd.	Total miles
Kansas City	0.17	$2.00	10.2	$2.80	18.82	$1.50	1.00	$1.75	2.52	$0.87	23.53
Topeka	3.51	....	11.00	2.80	2.16	....	4.03	1.28 1.78	....	....	20.70
Wichita	1.00	2.4[illegible]	2.33	2.80	....	....	0.38	2.03	....	.	3.70
Leavenworth	....	....	....	....	4.00	1.88	....	....	9.00	0.50	13.00
Atchison	0.04	1.44	....	....	1.96	1.90	3.33	1.65 2.00	2.42	0.60	*8.30
Fort Scott	....	....	....	....	....	....	....	....	5.00	0.35 upw's	5.00
Lawrence	....	.. .	....	....	....	....	....	....	2.25	0.40 0.50	2.25
Arkansas City	....	....	....	....	....	....	....	....	8.50	0.33	8.50
Emporia	....	....	....	. ..	....	....	....	....	1.50	....	1.50
Parsons	....	....	....	....	....	....	....	1.58	1.33	0.35	1.33
Pittsburg	....	....	....	....	....	...	1.00	...	....	....	1.00
Ottawa	†0.06	0.60	....	....	....	....	....	....	1.00	0.40	1.06
Winfield	....	....	....	....	....	....	....	....	2.00	....	2.00
Olathe	....	....	....	....	....	....	....	....	1.00	0.55 1.49	1.00
Totals	4.78	....	14.35	....	26.94	....	9.74	....	36.52	....	*92.87

* Includes ·55 mile of *bois d'arc* block pavement.
† Stone set on edge.

THE FIRST AMERICAN RAILWAY.

Mr. Lewis Cheney, of Chelsea, Mass., now 85 years old, enjoys the distinction of being the only man now living who worked upon the famous "Granite Railway," built in 1826, in Quincy, Mass., chiefly to transport stones for building Bunker Hill Monument. He chances also to have been the man who drove the horses which hauled the cars which carried the first load of stones over the road. The record given by the "Columbian Sentinel" of this historical event, whose importance was then little dreamt of, was as follows:

> This railroad, the first, we believe, in the country, was opened on Saturday (October, 1826) in the presence of a number of gentlemen, who take an interest in the experiment. A quantity of stone, weighing 16 tons, taken from the ledge belonging to the Bunker Hill Association, and loaded in three wagons, which together weigh five tons, was moved with ease by a single horse from the quarries to the landing above Neponset Bridge, a distance of more than three miles. The road declines gradually the whole way, from the quarry to the landing, but so slightly that the horse conveys back the empty wagons, making a load of five tons. After the starting of the load, which required some exertion, the horse moved with ease in a fast walk. It may, therefore, be easily conceived how greatly the transportation of heavy loads is facilitated by means of this road. A large quantity of beautiful stone already prepared for the Bunker Hill monument will now be rapidly and cheaply transported to the wharf at the termination of the railroad, whence it will be conveyed by lighters to Charlestown. The road is constructed in the most substantial manner. It rests on a foundation of stone, laid so deep in the ground as to be beyond the reach of frost, and to secure the rails on which the carriage runs effectually against any change in their relative position, they are laid on stones of 8 ft. in length, placed transversely along the whole extent of the road at a distance of 6 to 8 ft. from each other. The space between these stones is filled in with smaller stones or earth, and over the whole between the rails a gravel path is made. The rails are formed of pine timber, on the top of which is placed a bar of iron. The carriages run upon the iron bars and are kept in position by a projection on the inner edge of the truss wheels. The wheels are of a size considerably larger than a common cart wheel.
>
> We learn from a gentleman, who has visited the principal railroads in England, that in point of solidity and skill of construction this is not exceeded by any one there.

The latest plan for the elimination of grade crossings in Chicago is proposed by Mr. Millard J. Scott, and provides for a union central station at Grand Crossing, reached by all roads running to the city, the lines from the west and north running around outside the lower parts of the city, and the city traffic proper being accommodated by elevated railways.

An interesting experiment took place a few days ago, in the Vienna Technological Museum of Commerce, says the London "Standard," with a view to ascertain the relative resistance under pressure of the hardest steel and the hardest stone. Small cubes, measuring 0.39 in. on a side of corundum and of the finest steel were subjected to the test. The corundum broke under a weight of 13,216 lbs., but the steel resisted up to 94,528 lbs. It was curious to notice how the steel split up. It burst with a noise like the report of a gun, broke into a powder, and sent thousands of sparks in every direction, boring their way into the machine like shot.

In addition to the 36-in. Venturi meter mentioned in our issue of July 27 in connection with the water supply of the World's Columbian Exposition there is a 6-in. meter, also made by the Builder's Iron Foundry, of Providence, R. I. The 6-in. meter measures the water furnished by the Waukesha Hygeia Mineral Springs Co. as it passes from the cooling device at the company's pavilion. This meter is easily accessible, being near the exhibit of the Pennsylvania Railroad Co. at the south end of the Transportation Building.

The immigration since 1870 into the United States up to June 30, 1893, is given by a late return as follows:

Year ending June 30.	Immigrants arrived.	Year ending June 30.	Immigrants arrived.	Year ending June 30.	Immigrants arrived.
1871	321,350	1879	177,826	1887	490,109
1872	404,806	1880	457,257	1888	546,889
1873	459,803	1881	669,431	1889	444,427
1874	313,339	1882	788,992	1890	455,302
1875	227,498	1883	603,322	1891	560,319
1876	169,986	1884	518,594	1892	623,084
1877	141,857	1885	395,346	1893	497,936
1878	138,469	1886	334,203		

Arrivals from the British North American Possessions and Mexico are not included since Dec. 31, 1884.

CONSTRUCTION NEWS

RAILWAYS.

East of Chicago.—Existing Roads.

ADDISON & PENNSYLVANIA.—The work of widening this road is expected to be completed this month. The extension from Galeton to Austin, Pa., a distance of 40 miles, is also about completed.

BALTIMORE & OHIO.—Tracklaying on the Fairmont, Morgantown & Pittsburg road, between Morgantown and Smithfield, Pa., is progressing rapidly, according to reports. The Drake & Stratton Co., which has the contract, has a large force at work on the line, and expects to have the line completed within the next two months and ready for trains. The grading is all completed and the ties are on the ground.

BANGOR & AROOSTOOK.—The grading of this road between Brownville and Houlton, Me., 94 miles, will be practically completed this month. About 15 miles of track have been laid from Brownville and the work is progressing at about a mile a day. The road for 37 miles out of Houlton, including the most difficult work on the entire line, is also ready for the track. It is stated that 2,500 men are at work on the road and that trains will run from Bangor to Houlton by Nov. 1.

BOSTON & ALBANY.—The four-track line which now extends from Boston to Riverside is being continued to Wellesley and South Framingham. Curves are being straightened, grades raised, and one new bridge, 90-ft. span, will be built. It is reported that plans have been prepared for an elevated roadbed for four tracks from Faneuil to the Auburn St. bridge in Auburndale.

CENTRAL R. R. OF NEW JERSEY.—The grading has been commenced of a short line from Bound Brook to the north end of the bridge across the Raritan Bay at Perth Amboy, N. J. This is to cut off from the line of the seashore the long loop from Bound Brook around by Elizabethport, which is about 53 miles long, while the short cut will be only 17 miles.

CLEVELAND & SOUTHWESTERN.—It is stated that this company is about to issue $1,390,000 of 5% mortgage bonds for extensions. The company has been organized by the principal stockholders of the Cleveland, Lorain & Wheeling R. R. to build a short road into Cleveland from its own main line. The route was surveyed last spring, but the financial stringency delayed matters somewhat until the Cleveland, Wooster & Muskingum Valley R. R. a few weeks ago obtained authority to extend its road from Lodi to Cleveland. The routes are practically the same, and the company is endeavoring to get the right of way purchased and actual construction begun before any work is done on the other line.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—It is reported that a second track will be built this fall between Cincinnati and Springfield and Cincinnati and Indianapolis.

GEORGE'S VALLEY.—Work on this railway in Maine is reported as progressing rapidly.

KANAWHA & MICHIGAN.—This road from Charleston, W. Va., to Gauley Bridge and the Chesapeake & Ohio junction, a distance of 31 miles, has been completed and train service commenced.

OHIO SOUTHERN.—A branch line to Chillicothe, O., is being considered.

PHILADELPHIA & READING.—The Philadelphia & Newtown Connecting R. R., 1¼ miles long, connecting the Newtown road at Olney with the Tabor branch near Logan, has been completed.——It is reported that work will soon be resumed on the Philadelphia & Frankfort R. R. W. W. Foulkrod, Pres., Philadelphia.

Projects and Surveys.

CAMBRIDGE & CHESAPEAKE.—The commissioners of Dorchester county, Maryland, have voted to subscribe $75,000 toward this proposed railway, which, it is believed, insures the completion of the road. It will extend from Cambridge, Md., to Fox Creek, on Chesapeake Bay, a distance of about 30 miles, and it is reported that it has been surveyed and partly graded. Jas. Wallace, Pres., Cambridge, Md.

NEW MILFORD & LAKE WARAMAUG.—This railway company has been organized at New Milford, Conn.; Pres., N. Staub; Treas., I. B. Bristol; Gen. Man., D. E. Soule.

PITTSBURG, BELTZOOVER & KNOXVILLE.—Incorporated in Pennsylvania to build a railway 1½ miles long from Pittsburg through Beltzoover to Knoxville, Pa.; capital stock, $15,000; Pres., J. M. Bailey, Allegheny.

QUEENS & SHELBURNE.—A report from Shelburne, N. S., states that the construction of this proposed road will soon be commenced. The preliminary survey was made last year. Alexander Mitchell, Ch. Engr.

Southern.—Projects and Surveys.

DRY FORK.—A report from Charleston, W. Va., states that John W. Moore, Ch. Engr., has put a party of engineers on the preliminary line of this road and that this scheme has now been partially merged into the Point Pleasant, Buckhannon & Tygart's Valley R. R., the intention being to build a line from Buckhannon to Elkins along the valley of Roaring Creek, connecting at Buckhannon with the West Virginia & Pittsburg and to run thence by way of Elk River to Charleston.

NASHVILLE TERMINAL.—This railway company has been organized at Nashville, Tenn., and has petitioned for rights of way through the city; Jere Baxter, Thos. Parkes, J. A. Pitts, A. A. McCorkle.

Northwest.—Existing Roads.

CHICAGO & NORTHWESTERN.—The citizens of Cambridge, Wis., have voted to issue bonds for $5,000 to aid the branch from London, Wis., to that place.

CHICAGO & TEXAS.—The "Railroad Gazette" states that this company has been organized to operate the Grand Tower & Carbondale and the Grand Tower & Cape Girardeau railways in Illinois which are controlled by the St. Louis Ore & Steel Co. The new company will operate 57 miles of road from Carbondale to East Cape Girardeau, Ill. The northern half of this line, heretofore called the Grand Tower & Carbondale, has been in operation between Carbondale and Grand Tower, 31 miles, for some years. It was extended in 1887 under the name of the Grand Tower & Cape Girardeau, along the east bank of the Mississippi River, to Cape Girardeau, 26 miles. No changes are made in the organization of the company, E. K. Hitchcock, of St. Louis, continuing as president, and O. L. Garrison as vice-president.

DULUTH, MISSISSIPPI RIVER & NORTHERN.—It is reported that this road will be extended to the western end of the Mesabi iron range in Minnesota. W. A. Dafter, Ch. Engr., Swan River, Minn.

GREAT NORTHERN.—The citizens of Milbank, S. Dak., have appointed a committee with a view to making that city a prominent point on the proposed branch of this road from Brown's Valley, Minn., to extend southward to a junction with the Sioux City & Northern.

Projects and Surveys.

TERRE HAUTE, SAYLORS SPRINGS & MOUNT VERNON.—Much of the right of way is reported as already secured for this proposed road, noted in our issue of Aug. 3.

Southwest—Existing Roads.

GREENFIELD & NORTHERN.—Work on this road north of Greenfield, Mo., has been suspended. It is stated that the money has been secured and that work will be commenced about Sept. 1 and the road completed.

KANSAS CITY, PITTSBURG & GULF.—This company has secured 15 acres of land at Pittsburg, Mo., upon which shops will be erected, it is reported.

Rocky Mt. and Pacific—Existing Roads.

NEVADA SOUTHERN.—The first section of this road has been completed. The line extends from Blake, Cal., on the Atlantic & Pacific, to Summit, Cal., a distance of 30 miles. The route has been surveyed 60 miles further to Good Springs, Nev.

NORTHERN PACIFIC.—It is reported that this road will be extended to Aberdeen, Wash., if the city will pay $30,000.

Projects and Surveys.

CALIFORNIA.—A report from Moreno, Cal., states that a company is being organized to build a railway from that place to Lakeview, San Jacinto, Hemet and Redlands, and that the construction will soon be commenced.

PUEBLO, GUNNISON & PACIFIC.—Thos. T. Player, Pres., Pueblo, Colo., is reported as stating that the line has been located from Pueblo to Walsenburg, 61 miles, and a preliminary survey made thence into the San Luis valley. The state of the money market has delayed the proposed construction.

STREET RAILWAYS.

BIDDEFORD, ME.—A press report states that the Boston & Maine R. R. is negotiating for the Biddeford & Saco street railway. The scheme includes an extension down Ferry road to Camp Ellis, the entire system to be operated by electricity.

POLAND, ME.—It is reported that Hiram Ricker & Sons are contemplating an electric railway between Danville Junction and Poland Springs.

AUBURN, MASS.—The selectmen have granted the Worcester, Leicester & Spencer St. Ry. Co. a location for its Stoneville branch.

HAVERHILL, MASS.—A reference was made recently to surveys for an electric railway to Nashua, N. H. The proposed power station would be at Salem, N. H., and branch lines would be built to Manchester, Lowell, Lawrence, Chester and other places, as well as through this city to West Newbury and Newburyport. Chas. Corliss is interested in the project.

WORCESTER, MASS.—The Worcester & Millbury St. Ry. Co. has been granted permission to increase its capital stock from $150,000 to $300,000.

NEW HAVEN, CONN.—The West Shore Ry. Co. is being organized by Henry Sutton, W. W. Ward, J. D. Dewell and others to build an electric railway 11 miles long to the outlying districts; capital stock, $100,000.

NORWALK, CONN.—The Norwalk Tramway Co. has decided upon extensions to Stamford, New Canaan, Westport, Five Mile River and Darien; Pres., G. F. McKibben; capital stock, $70,000.

MOUNT VERNON, N. Y.—It is reported that the Union Electric R. R. Co. will make a new proposition to the council whereby it agrees to complete the proposed road by June 1, 1894.

ROME, N. Y.—The "Sentinel" states that H. G. Canfield contemplates an electric railway on Main and River streets in Unadilla and to the South Unadilla station.

NEWARK, N. J.—The Wilcox Electric Co. has been incorporated by T. B. Wilcox, E. R. Dimick and others to build and equip electric railways; capital stock, paid up, $150,000.

FRANKLIN, PA.—The Franklin & Oil City Electric St. Ry. Co. has been incorporated to build an electric railway from this city through Reno to Oil City, all in Venange Co.; capital stock, $45,000; Pres., James Roy, Warren.——The Franklin Electric St. Ry. Co. has been incorporated to build an electric railway from this city to Big Rock bridge; capital stock, $24,000; Pres., Alex. H. McKelvey, Warren.

McKEESPORT, PA.—The council of the new borough of Port Vue has granted the McKeesport & Reynoldton Passenger Ry. Co. the right of way to lay tracks in every street in the town, work to be commenced in 90 days.

PHILADELPHIA, PA.—Jos. H. Hinkson, Philadelphia, Pres. Philadelphia & Delaware St. Ry. Co., is reported as stating that franchises for the proposed road have been secured from the townships of Tinicum, Ridley, Eddystone, South Chester, Chester, Aston and Lower Chichester, and that over $400,000 of stock has already been sold.

MOUNDSVILLE, W. VA.—The Benwood Southern St. Ry. Co. has been incorporated by B. F. Peabody and others to build a street railway from this city to Benwood; capital stock, $500,000.

CHARLESTON, S. C.—The Enterprise R. R. Co. has been granted a franchise to make extensions, the work to be completed by Jan. 1, 1894.

COVINGTON, KY.—The South Covington & Cincinnati St. Ry. Co. is preparing to extend its electric road about two miles.

YOUNGSTOWN, O.—It is reported that the Lauterman's Falls Improvement Co., which has arranged to build an electric railway line, and the Youngstown & Canfield Ry. Co. have consolidated, and that work will soon be commenced on the new line.

MARTINSVILLE, IND.—A special election will be held in Morgan county Aug. 22 to vote on an appropriation of $55,000 in aid of the proposed electric railway from this city to Indianapolis.

MUNCIE, IND.—Arrangements are being made whereby the motive power of the Muncie St. Ry. will be changed from steam to electricity.

NOBLESVILLE, IND.—Samuel Hanway, Indianapolis, has been engaged to superintend the construction of the proposed electric railway from this city to Indianapolis. It is stated that the present force of 500 men at work on the line will soon be increased.

DEARBORN, MICH.—The work of grading for the Detroit & Dearborn Electric Ry. has been commenced near this place.

CANTON, ILL.—The Canton City Ry. Co. has been incorporated by J. M. Snyder, C. H. Martin and C. N. Henkle; capital stock, $100,000.

COLLINSVILLE, ILL.—Efforts are being made to raise $12,000 toward the construction of an electric railway to East St. Louis, according to reports.

GALENA, ILL.—The "Gazette" states that Congressman Haines promises to commence work on the Freeport electric railway this week.

DES MOINES, IA.—The Des Moines City Ry. Co. has been incorporated by J. S. Polk, G. M. Hiffee and others; capital stock, $3,000,000. This company, according to reports, is a consolidation of all the street railway companies of the city.

IOWA CITY, IA.—The franchise granted to Haines Bros. & Tilden has expired and there is talk of a local company being organized to construct the proposed road.

COTE VISITATION, QUE.—It is reported that the street railway company will commence a line on Papineau and Mount Royal avenues this fall.

HIGHWAYS.

MASSACHUSETTS.—The commissioners of Bristol county are considering plans for a new highway over the line of the old Norfolk and Bristol turnpike, which was the continuation of Washington street, New Bedford, through Dedham, Norfolk, Walpole and Wreatham to Providence. The road would be about 40 miles long.

MARYLAND.—A petition has been filed with the commissioners of Baltimore county for a highway from Reisterstown turnpike to Pikesville Station.

OHIO.—The commissioners of Hamilton county will receive bids until Aug. 26 for improving Columbia avenue, Columbia Township. John Hagerty, Co. Aud., Cincinnati.

BRIDGES.

CONCORD, N. H.—Bids are asked by the council until Aug. 31 for a 496-ft. iron bridge across the Merrimack River at Bridge St.; estimated cost, about $19,000.

ALBANY, N. Y.—The state canal board has approved plans for work estimated to cost $210,000. The work includes canal bridges at Buffalo, raising the approaches to bridge at Weedsport, and substructure of bridge at DeWitt.

LOUISVILLE, KY.—Bids will be received at the U. S. Engineer Office until Sept. 12 for constructing and erecting two new drawbridges and one new fixed span over the Louisville & Portland Canal and the removal of the old drawbridges and the re-erection of one of them. Lieut. Hiram M. Chittenden, U. S. A.

CINCINNATI, O.—The commissioners of Hamilton county will receive bids until Sept. 2 for the superstructure, substructure and protection piling for the Miamitown bridge, Colerain and Whitewater townships. John Hagerty, Co. Aud.

CARLYLE, ILL.—The board of supervisors and highway commissioners have advertised for bids for the erection of an iron bridge over the Kaskaskia River at White's Ford, two miles south of this city.

ST. CLOUD, MINN.—An election has been held to vote on a $50,000 bonus for the reconstruction of the St. German St. bridge across the Mississippi River or for the building of a new $75,000 steel structure.

LITTLE ROCK, ARK.—Bids are asked until Sept. 4 for the construction of a public highway bridge across the Arkansas River in this city. H. G. Fleming, Engr.

WATER-WORKS.

PRESQUE ISLE, ME.—It is reported that the system will be extended to Gouldville.

MANCHESTER, N. H.—The contract for laying section 1 of the force main has been awarded to Bartlett, Gay & Young, Manchester, at $17,532. The work includes 14,800 cu. yds. earth excavation, 3,500 cu. yds. earth embankment, 1,400 cu. yds. rock excavation, 11,860 lin. ft. laying 20-in. pipe, 50 lin. ft. 10-in. and 100 lin. ft. 6-in. pipe, 8 hydrants, 530 lbs. wrought iron and 24 cu. yds. masonry of different kinds. The other bids were as follows: Flood & Sherrill, Sandy Hill, N. Y., $16,191; Inman Bros. & Jas H. Edwards, $17,550; Conrad Juul, Danvers, Mass., $18,530; Moore & Co., Boston, $19,086; E. H. Burlington, Providence, $19,139; Maney & Gannon, Quincy Point, Mass., $21,446. Geo. E. Evans, Engr., Boston.

MORRISVILLE, VT.—A meeting will be held Aug. 18 to see if the village will purchase the present plant or take steps to secure a new supply.

AMHERST, MASS.—Plans are being considered for increasing the supply.

BEVERLY, MASS.—The report of the committee recommending an additional supply has been unanimously adopted.

BOSTON, MASS.—It is stated that surveys are being made at West Brighton under the direction of F. P. Richardson, Engr. State Board of Health, with a view to building a dam 100 ft. high, across the Nashua River for a reservoir, which would be nearly nine miles long, for a metropolitan water supply system.

CHICOPEE, MASS.—The commissioners have been granted authority to purchase 4,000 ft. 6-in. and 2,850 ft. 4-in. pipe.——The contract for pumping station, boiler-house, chimney and foundations for the pumping engine has been awarded to Dennis Murphy, at $8,588.

FOXBORO, MASS.—W. G. Lanphier writes us concerning the proposed water supply for West Foxboro and Lake View that the present charter covers a district but a half mile from the village and it is proposed to petition for an amendment so as to extend the present system. If this is not obtained an independent supply will probably be secured.

MARLBORO, MASS.—The commissioners have recommended that additional land near Lake Williams be purchased to preserve the purity of the supply.

NORTH ANDOVER, MASS.—L. N. Farnum has prepared plans for a supply from Great Pond; estimated cost, about $100,000. E. W. Greene, Chn. Com.

WEBSTER, MASS.—McClellan & Hennessey, North Brookfield, have been awarded the contract for a filter well, 26 ft. inside diameter and when completed to deliver 1,000,000 gallons each 24 hours, at $6,940 for the first 20 ft., $500 for each additional foot up to 25 ft. and $750 per ft. from 25 ft. to 30 ft.

WEST BOYLSTON, MASS.—The town clerk writes us that probably but little will be done at present for works. The proposed source of supply is not considered by some to be sufficient in dry seasons and the question has been postponed.

NEWINGTON, CONN.—Newton Osborn is a member of a committee apointed to tighten and enlarge the reservoir of the Newington Water Co.

NEW LONDON, CONN.—The council has directed that steps be taken to secure an additional supply according to plans approved last April.

COHOES, N. Y.—The superintendent has been instructed to confer with manufacturers as to the cost of pumps.

HAMBURG, N. Y.—Mains are to be laid in the new portions of the village.

JEFFERSON, N. Y.—We are informed that the Jefferson Water-Works Co. is putting in works to cost about $6,000. The supply is from mountain springs and there are 1½ miles of mains with a reservoir at about 200 ft. elevation.

MIDDLETOWN, N. Y.—The question will be submitted to a vote of the taxpayers Aug. 22.

MOUNT KISCO, N. Y.—At an election Aug. 15 the citizens voted not to put in works, and it is reported that a franchise will be awarded to a private company.

WATERBURY, N. Y.—The new reservoir recently ordered will soon be constructed, according to reports.

BAYONNE, N. J.—A public hearing has been held to consider a better supply.

MAY'S LANDING, N. J.—A supply for fire protection will soon be secured, according to reports.

SOUTH AMBOY, N. J.—The citizens have voted in favor of bonds for $30,000 for a supply.

BELLWOOD, PA.—The Bellwood Water Co. has been incorporated; capital stock, $30,000.——T. K. Downing, Clk., informs us that the borough will soon award contracts for a supply from Laurel Run, 1¾ miles distant; estimated cost, $16,500.

BENNETT, PA.—Plans have been prepared for works estimated to cost $66,000 and the contract for construction will be awarded as soon as possible.

CARBONDALE, PA.—The Vandling Water Co. has been incorporated; capital stock, $1,000.

DRIFTWOOD, PA.—It is reported that works will soon be constructed at a cost of about $10,000.

DUSHORE, PA.—The Dushore Water Co. has been incorporated; capital stock, $16,000.

MIFFLINBURG, PA.—Plans have been prepared by Fred P. Gutelius, Butte, Mont., for a supply from Buffalo Creek, where a headworks dam would be constructed. The plans provide for an 8-in. cast iron main two miles to a 1,500,000-gallon reservoir at an elevation of 200 ft. and thence an 8-in. pressure main three miles to the town distribution system, which would consist of four miles of 8 to 4-in. mains with 40 hydrants; estimated cost, $34,500.

BRISTOL, VA.—A reservoir is proposed in order to secure a better supply.

MACON, GA.—The board of aribitration has reported in favor of $550,000 as the sum to be paid by the city to the Macon Gas Light & Water Co. for the works.

NEWNAN, GA.—N. Wilson Davis, Engr., Atlanta, informs us that the contract for works, recently advertised in this paper, has been awarded to Howard Nealey, Athens, at $35,470, the other bids being as follows: Gude & Walker, Atlanta, $44,869; Brooks & Carter, Birmingham, Ala., $43,388; R. D. Cole Mfg. Co., Newnan, $41,980; Thos. Houser & Co., Anniston, Ala., $41,306; Guild & White, Chattanooga, Tenn., $41,003; Fairbanks, Morse & Co., Chicago, $40,789; Perkins Bros. & Co., Birmingham, Ala., $40,156; Livingston & Martin, Atlanta, $40,099; D. Wardrober Co., Chattanooga, Tenn., $39,924; Herbert & Lepeyse, Chattanooga, Tenn., $39,244; Patrick Keiley, Atlanta, $37,698.

GAINESVILLE, FLA.—The county commissioners have granted the city the right of way to lay a main in the road to Boulware Springs.

CINCINNATI, O.—The board of administration will receive bids until Aug. 26 for four steel tanks for Price Hill, each to be 30 × 30 or 30 × 50 ft. and supported by an iron trestle or masonry foundation; also for a stone, brick or iron tank-house.——The following bids have been received for four vertical pumps, 4,500,000-gallons capacity, (1) being at Front St. and (2) at Eden Park: Henry R. Worthington, New York, (1), $16,191, $27,293, $13,177, (2) $41,550; Wilson-Snyder Co., Pittsburg; (1) $7,900, $8,500, (2) $34,500; Groshon High-Pressure Engine Co., New York, (1) $13,309, $10,309; Fraser & Chalmers, New York, (2), $35,945; Laidlaw-Dunn-Gordon Co., Cincinnati, (1), $11,790, (2) $30,615; Barr Pumping Engine Co., Philadelphia, (1) $7,200, $8,400, $9,250, (2), $18,660 (probably a mistake).

MASSILLON, O.—The plant of the Massillon Water Co. was sold at auction Aug. 5 to Wm. A. Lynch, at $77,000. Mr. Lynch is reported to have purchased the works for W. G. Snow, New York, representing a majority of the stockholders.

NORWALK, O.—D. W. Smith, New London, has been awarded a contract for the test wells recently authorized.

PLAIN CITY, O.—Bids will be received until Aug. 19 for works. G. E. Kilbury, Tn. Clk.

READING, O.—The citizens have voted to construct a reservoir. This item was erroneously credited last week to Reading, Pa.

ALEXANDRIA, IND.—It is reported that the city contemplates putting in works.

FRANKFORT, IND.—The committee has recommended extensions in several streets.

GREENFIELD, IND.—An election will be held Sept. 12 or 13 to vote on the question of municipal works.

HAMMOND, IND.—It is reported that the system is to be extended to West Hammond.

LOGANSPORT, IND.—The contract for a 3,000,000-gallon steam pump and a 125 HP. boiler has been awarded to Fairbanks, Morse & Co., Chicago, at $9,550. The contract for the power pump, same capacity, was awarded to A. W. Stevens, Logansport, at $7,005.

WEST BAY CITY, MICH.—Extensions have been ordered in several streets.——It is reported that the pumps have been spoiled by pumping sand and that new ones will have to be purchased.

CARBONDALE, ILL.—Owing to recent fires the necessity of works is being urged.

CHICAGO, ILL.—Bids are asked until Aug. 21 for mains in California Ave. H. J. Jones, Comr. Pub. Wks.

GARDNER, ILL.—Frank Bookwalter, Vil. Clk., writes us that the village will not put in works during the present financial stringency.

ROCK FALLS, ILL.—The city attorney is a member of a committee appointed to investigate the question of works.

MANAWA, WIS.—The citizens are discussing the question of works.

REEDSBURG, WIS.—Bonds for $25,000 have been voted for works. C. C. Steven, Cy. Clk.

CALEDONIA, MINN.—The contract for works has been awarded to A. Turner, Waukon, Ia., and L. O. Palmer, Caledonia, at $7,650.

PRINCETON, MINN.—The council has decided to secure a supply for fire purposes, according to reports.

ST. CLOUD, MINN.—The council is considering the purchase of works, according to reports.

THIEF RIVER FALLS, MINN.—The village is about to construct works, according to reports.

ALLIANCE, NEB.—Bonds have been voted for $17,000 for works.

YORK, NEB.—The York Water Co. has been incorporated by D. E. Sedgwick, S. H. Sedgwick, G. S. Post and E. J. Wightman; capital stock, $60,000.

BELLE FOURCHE, S. DAK.—G. E. Hair, Secy. Belle Fourche Water Co., informs us that a supply of artesian water was struck Aug. 2 and that additional work will soon be decided upon.

DEADWOOD, S. DAK.—It is reported that $10,000 will be spent for a new reservoir.

MANDAN, N. DAK.—Bonds for $5,000 have been voted for extending the mains.

OAK CLIFF, TEX.—Plans are being made for an extension of the water-works and electric plant, the work to be commenced at an early day, according to reports.

BOULDER, COLO.—An election will be held Sept. 12 to vote on an issue of bonds for $50,000 to complete the works.

COLORADO SPRINGS, COLO.—The council has accepted a recommendation of the city engineer in favor of constructing a box ditch 6,200 ft. long and that the work of building reservoir No. 2 be commenced, and voted an appropriation of $15,000.

COLVILLE, WASH.—An engineer has been engaged to prepare plans for works, it is reported.

PUYALLUP, WASH.—Wm. M. Seeman, Cy. Clk., informs us that the bond election resulted 160 votes for bonds and 123 against, the required three-fifths not being received.

TACOMA, WASH.—The board of public works has directed the city engineer to proceed at once with the survey of Patterson and Thomas springs.

SACRAMENTO, CAL.—The trustees have voted to accept the proposition of R. L. Fish, San Francisco, for a supply for 20 years at 3.9 cts. per 1,000 gallons for 1,000,000 gallons and 2 cts. per 1,000 gallons for all additional. A special election has been called for Aug. 26 to vote on the question.

MONTREAL, QUE.—The committee has reported in favor of improvements estimated to cost $100,000, including a 10,000,000-gallon pump.

ARTESIAN WELLS.

MADISON, IND.—It is reported that the council favors a proposition to sink several wells.

BUTTE, NEB.—At an election Aug. 9 the citizens voted to issue bonds for $3,000 for an artesian well.

IRRIGATION.

NEW COMPANIES.—Tulare Investment & Irrigation Co., San Francisco, Cal.; $750,000; J. H. Smith, Portland; R. C. Cushing, Omaha; G. L. Dillman, Bakersfield, and others.——Idaho & Oregon Irrigation Co., Payette, Idaho; $100,000.——Samaria South West Mountain Irrigation Co., Samaria, Idaho.——St. Anthony Land & Water Power Co., St. Anthony, Idaho; $10,000.——Mima Irrigation, Land & Hop Co., Mima, Wash.; $30,000.

SEWERS.

HALLOWELL, ME.—A sewer is to be constructed from the foot of Central St. to the foot of Temple St., the work to be commenced immediately.

PORTSMOUTH, N. H.—C. P. Berry, Mayor, has recommended that an engineer be employed to make plans for a system, and that bonds be issued for the construction.

CAMBRIDGE, MASS.—The city engineer is preparing plans for the improvement of Broad Canal.

HAVERHILL, MASS.—John T. Desmond, Cy. Engr., informs us that plans have been prepared for 566 lin. ft. 36 x 46 ft. brick sewer, average cut 8 ft.; 2,170 lin. ft. 30-in. brick sewer, average cut 10 ft., and 540 lin. ft. 18-in. pipe sewer, average cut 9 ft., but that if the work is done this season it will be by day labor.

HOLYOKE, MASS.—The committee has requested a loan of $20,000 for the Elmwood and Oakdale sewers.

MILTON, MASS.—Geo. A. Kimball, Boston, has been engaged to prepare plans for a system.

NORTH BROOKFIELD, MASS.—Engineer Craig, Spencer, is preparing plans for the proposed extensions.

HARTFORD, CONN.—A city meeting was called for Aug. 16 to vote on the question of the proposed Park River sewer.

NEW HAVEN, CONN.—The committee has decided that the awarding of contracts shall not be restricted to resident contractors.

NORWALK, CONN.—The city engineer has been authorized to advertise for bids for the Ann St. sewer.

HAVERSTRAW, N. Y.—The state board of health has approved the plans for a system. Dr. N. B. Bayley, Pres. Comrs.

LOCKPORT, N. Y.—Plans have been prepared by Chas. H. Cornes, Cy. Engr., for 1,800 lin. ft. 15 to 10-in. pipe sewer, average cut 8 ft., and the contract will probably be awarded Aug. 21.

NEW YORK, N. Y.—Bids are asked until Aug. 24 for sewers in Locust and Willow Aves. Louis F. Haffen, Comr. St. Impvts., Wards 23 and 24.

SALAMANCA, N. Y.—Petitions are being circulated for sewers in several streets.

UTICA, N. Y.—Bids have been asked for a sewer in Hotel St., according to reports; estimated cost, $50,000.

WHITE PLAINS, N. Y.—The trustees have decided to put in two Shone ejectors, at a cost of about $12,650.

NEW BRUNSWICK, N. J.—The committee will receive bids until Aug. 25 for a sewer in Burnet St.

SMYRNA, DEL.—A committee has been appointed to secure plans, it is reported.

WASHINGTON, D. C.—The commissioners have voted to reject the bids received July 7 for sewer brick, and to ask for new bids.

MACON, GA.—The mayor has been instructed to sign a contract with Samuel M. Gray, Providence, for plans for a system, the city to pay Mr. Gray $50 and expenses for each day employed and $1,200 for making the maps, etc.

ASHLAND, KY.—The following bids have been received for a sewer in 17th St.; Moriarty & Mulligan, $8,324; T. Russell, Sr., $7,511; H. C. Schump, $8,833; W. H. Chisholm, $8,238; J. A. Kelly, $10,100.

CANTON, O.—It is proposed to vote on the issue of bonds for $75,000 for a sewer in Shriver's Run.

SAGINAW, MICH.—A contract has been awarded to A. Lamson at $10,350.

CHICAGO, ILL.—Bids are asked until Aug. 21 for sewers in several streets. H. J. Jones, Comr. Pub. Wks.

JANESVILLE, WIS.—The council has directed O. G. Bleedorn, Cy. Engr., to prepare estimates for sewers, according to plans already adopted.

MARINETTE, WIS.—Bids are asked until Aug. 21 for a system, it is reported.

BURLINGTON, IA.—Wm. Steyh, Cy. Engr., informs us that bids will be received until Sept. 4 for 48 and 42-in. brick sewers, average cut 10 ft., estimated cost $6,750, and 24 to 9-in. pipe sewers, average cut 9 ft., estimated cost $25,600; five contracts.

LYONS, IA.—Bids are asked until Aug. 22 for a 12-in. pipe sewer. I. N. Manville, Cy. Clk.

OTTUMWA, IA.—The street committee has been authorized to advertise for bids for a 4-ft. brick sewer.

HAYWARDS, CAL.—The trustees have decided to issue bonds for $33,000 for a system.

STREETS.

MANCHESTER, N. H.—The mayor has asked for an additional appropriation of $31,000 for the department of highways and bridges.

CHELSEA, MASS.—The bids for paving three streets have been rejected, and the work will be done by the street department.

SALEM, MASS.—The council has appropriated $24,000 for Harmony Grove St. and $6,000 for widening Leavitt St.

COHOES, N. Y.—A petition is being circulated for the paving of Ontario St. from Remsen St. to the easterly branch of the railway.

JOHNSTOWN, N. Y.—The town is reported as about to macadamize the streets of the village.

LOCKPORT, N. Y.—Charles H. Corves, Cy. Engr., informs us that bids will probably be opened Aug. 21 for 45,000 sq. yds. of brick paving, as follows: Buffalo St. 800 lin. ft.; West Ave., 400 lin. ft.; Main St., 2,300 lin. ft.; East Ave., 4,000 lin. ft.

NEW YORK, N. Y.—The commissioner of street improvements in wards 23 and 24 will receive bids until Aug. 24 for paving two streets with granite blocks.

ROCHESTER, N. Y.—The contract for paving Campbell St. with asphalt has been awarded to the Rock Asphalt Paving Co., at $27,512; estimate, $29,000.

SCHENECTADY, N. Y.—The council has voted to pave Jay St. with asphalt blocks, the work to commence May 1, 1894.

TROY, N. Y.—The city engineer is preparing plans for paving Davison St.

CINCINNATI, O.—For paving Lincoln Ave., Walnut Hills, with asphalt the Warren-Scharf Asphalt Paving Co. bid $18,182 and the Trinidad Asphalt Paving Co. $18,271; estimate, $19,000.

COLUMBUS, O.—The council has voted to pave several streets with asphalt, stone or brick.

ELMWOOD PLACE, O.—The council will receive bids until Sept. 5 for grading, macadamizing, etc., in four streets. John Kindel, Clk.

HAMILTON, O.—The city engineer estimates that it will cost $47,000 to pave High St.

MASSILLON, O.—E. B. Bayliss, Cy. Clk., will receive bids until Aug. 25 for $28,000 of West Main St. street improvement bonds.——Loeffler & Dennison have completed 8,000 sq. yds. of paving in West Main St., at $1.09 per sq. yd.

NORWALK, O.—Bids are asked until Sept. 5 for paving Linwood Ave. with brick. F. W. Christian, Cy. Clk.

VAN WERT, O.—G. L. McKibben, Cy. Engr., informs us that bids will soon be asked for 4,000 lin. ft. of curbing for South Washington St., also later for macadamizing 800 lin. ft. of Water St., 40 ft. wide.

WINTON PLACE, O.—Bids are asked until Aug. 22 for a stone gutter in Winton Road. R. B. Poage, Vil. Clk.

NEW ALBANY, IND.—There is talk of paving several streets with brick.

SAGINAW, MICH.—The contract for paving Washington Ave. with brick has been awarded to H. S. Hallwood, at $26,000.

AURORA, ILL.—No bids were received Aug. 5 for 13,000 sq. yds. paving with cedar blocks and 2,960 yds. paving with brick.

CHICAGO, ILL.—Bids are asked until Aug. 21 for paving 89th St. H. J. Jones, Comr. Pub. Wks.

KEOKUK, IA.—The city engineer has been directed to advertise for bids for macadamizing 12th St., between Seymour and Grand Aves., with 5 ins. rough macadam, 5 ins. fine macadam and 2 ins. gravel.

KANSAS CITY, MO.—John Donnelly, Cy. Engr., will receive bids until Aug. 22 for sidewalks and street improvements.——The council has passed ordinances for work estimated to cost about $60,000, including paving with asphalt and macadam.——The report of the city engineer for the three months ending June 30 showed that 54,378 sq. yds. brick paving had been constructed at a cost of $89,578, 21,029 sq. yds. asphalt costing $53,079, and 5,428 sq. yds. macadam costing $4,136. June 30 the following work was under contract, more than $100,000 worth having been added since then: Macadam paving, $60,026; brick, $79,943; asphalt on concrete $236,202; miscellaneous, $199,817.

ELECTRIC LIGHT AND POWER.

BIDDEFORD, ME.—The York Light & Heat Co. has offered to furnish 74½ arc lights at $5,312 and additional lights at $75 each per year for a five-year contract. A contract for one year is proposed.

MADISON, ME.—The citizens have voted to purchase water-power below the village; also to have surveys and plans made for an electric light plant.

PROVIDENCE, R. I.—The arbitrators appointed several months ago to fix the price to be paid by the city to the Narragansett Electric Lighting Co. for lighting the streets by electricity have reported in favor of 38½ cts. per night for each arc light.

BROOKLYN, N. Y.—R. B. Eastman, supervising architect, has prepared plans for the proposed electric light station at St. Johnland.

FLATBUSH, N. Y.—The town board has voted to receive bids until Aug. 24 for lighting the streets. The town now uses 1,500 gas lights and 300 electric lights.

JAMAICA, N. Y.—Bids have been received for all-night lights as follows: Arc electric lights, $80 per light per year; gas, $25; self-generating gas lamp, $21. It is proposed to award a contract for one year with a view to a municipal electric light plant.

RICHMOND, IND.—The Richmond Light, Heat and Power Co. has offered to put in a plant and furnish 150 or more 2,000-c. p. arc lights at $90 each per year and 16-c. p. incandescent lights at a price not to exceed 1 cent each per hour, provided a franchise is granted for 25 years and a contract for lighting for 10 years.

ROCK FALLS, ILL.—A committee has been appointed to investigate the feasibility of a municipal electric light plant.

NEW COMPANIES.—Queen City Electric Light Co., Denver, Colo.; $25,000; Chas. E. Shields, F. J. Hangs, Wm. Thorne.——Wilcox Electric Co., Newark, N. J.; $150,000; T. B. Wilcox, Henry Wilcox, E. K. Dimmick.——National Thermograph & Electric Co., Chicago, Ill.; $500,000; E. W. Applegate, J. T. Todd, J. Marks.——Portland & Hillsboro Ry. Co., Portland, Ore.; $1,500; operating electric light and power plants.——Santa Cruz Electric Navigation Co., Santa Cruz, Cal.; $10,000; operating boats by electricity, etc.

CONTRACT PRICES.

ASPHALT BLOCK PAVING.—Baltimore, Md.—The Maryland Paving Co. has been awarded a contract for paving 18,526 sq. yds. with asphalt blocks, at $2.50 per sq. yd. for paving, and 93¾ cts. per lin. ft. for 6-in. curbing.

BRICK PAVING.—Mansfield, O.—The contract for paving West Fourth St., 2,790 lin. ft., has been awarded to Daum & Boebel, at $1.01½ per sq. yd. for Canton Royal brick, 31½ cts. per lin. ft. of stone curbing, and 10 cts. per sq. yd. for rolling with steam roller.

Tonawanda, N. Y.—The contract for paving Delaware St., 40 ft. wide, with brick, from the village limit to the city line of Buffalo, has been awarded to Edward H. Rogers, Jr., at $2.94 per sq. yd.

PIPE.—Kalamazoo, Mich.—The city has awarded a contract for about one-half mile of water pipe to J. W. Clow & Son, at $21 per ton for pipe and 2¼ cts. per lb. for special castings. It is stated that the city paid $23.60 per ton for the pipe purchased last year.

HIGHWAY WORK.—Steubenville, O.—Contracts for repairing highways with broken limestone have been awarded as follows: Jos. Edwards, $1.65 per cu. yd.; Jos. Murphy, $1.65; Michael Coen, $1.70; McConnell & Hill, $1.60; Tweed & McConnell, $1.59.

MISCELLANEOUS.

LEVEES.—White Hall, Ill.—Bids are asked until Sept. 1 for constructing about two miles of levee, as stated in our advertising columns. Louis Lowenstein.

Shreveport, La.—The commissioners of the Caddo levee district will receive bids until Sept. 5 for four contracts, aggregating 57,000 cu. yds. of work.

New Orleans, La.—It is reported that Major Richardson, Ch. Bd. State Engrs., will receive bids until Aug. 23 for the following levees: Rush Bayou (enlargement), in Caddo Parish, about 30,000 cu. yds.; from Baton Rouge, down East Baton Rouge Parish, 100,000 cu. yds.; St. Paul Store, St. John Parish, 25,000 cu. yds.; Louisa, St. Charles Parish, 75,000 cu. yds.; Cedar Grove, Jefferson Parish, 40,000 cu. yds.; Fairview to Bellevue, Plaquemines Parish, 100,000 cu. yds.

MAP-MAKING.—Independence, Mo.—Bids are asked until Sept. 1 for a complete topographical map of the city. H. H. Pendleton, Cy. Engr.

CENTRIFUGAL PUMPS.—New Orleans, La.—The council is considering a resolution directing the city comptroller to advertise ten times in 30 days for bids for the construction of centrifugal pumps for the Bienville and Melpomene drainage districts.

RETAINING WALL.—Scranton, Pa.—The city engineer has been directed to prepare plans for a retaining wall.

DRAINAGE CANAL.—Chicago, Ill.—The board of trustees of the sanitary district of Chicago will receive bids until Oct. 4 for excavating sections 2, 3 and 4 of the main drainage canal, as stated in our advertising columns. Thos. F. Judge, Clk.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Manchester Locomotive Works, Manchester, N. H., are building 8 engines for the Bangor & Aroostook, 4 of which have been delivered.

The Brooks Locomotive Works, Dunkirk, N. Y., are building 10 ten-wheel engines for the Toledo & Ohio Central, 2 of which have been delivered.

The Rhode Island Locomotive Works, Providence, R. I., have delivered 10 engines for the Lake St. elevated road, Chicago, and are building 10 compound engines for the same road.

CARS.—The Jackson & Woodin Mfg. Co., Berwick, Pa., has delivered 150 flat cars, 6 cabooses, 1 passenger and 1 combination baggage and passenger car to the Bangor & Aroostook and more will be delivered this month.

The Michigan Peninsular Car Co., Detroit, has an order from the New York, Lake Erie & Western for 1,000 box cars, at $660 each.

STEEL RAILS.—The Pennsylvania Steel Co., Philadelphia, is delivering 11,000 tons of 70-lb. steel rails for the Bangor & Aroostook.

NEW COMPANIES.—Pacific Asphaltum Pipe Co., San Francisco, Cal.; $250,000; W. B. Carr, F. G. Drum, M. M. Estee.——McArthur Bros. Co., Chicago, Ill.; $250,000; to construct railways, canals, sewers, etc.; Henry W. Magee, G. E. Wister, A. F. McArthur.——W. M. Goldie & Sons, Chicago, Ill.; $50,000; to construct buildings and bridges; H. W. Magee, G. E. Wister, Wm. Goldie, Jr.